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ORIGINAL

Use of radiographs in endodontic treatments in pregnant women

Uso de las radiografías en los tratamientos endodónticos en embarazadas

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ABSTRACT

X-rays are an effective method to diagnose alterations in hard tissues, which is why they are used in dental treatments; in Endodontics they are very useful. Pregnant women receive comprehensive dental care that includes pulpo-radicular treatments. The objective was: to describe the theoretical basis for the use of radiographs in pregnant women in need of endodontic treatment. A bibliographic review was carried out taking into account the most up-to-date scientific literature on the subject. 19 bibliographies were used. For the development of the research, the methods of documentary analysis, analytical-synthetic, and historical-logical analysis were used. The biological and clinical effects of X-rays, embryonic stages and their susceptibility to radiation, the use of X-rays in pregnant women and protective measures were presented. X-rays are not contraindicated in endodontic treatments in pregnant women, and are recommended in the second and third trimester of pregnancy.

Keywords: Endodontics; Pregnancy and Oral Health; Dental X-Ray.

RESUMEN

Las radiografías son un método eficaz para diagnosticar alteraciones en los tejidos duros por lo cual son utilizadas en los tratamientos dentales, en la Endodoncia son de gran utilidad. Las embarazadas reciben una atención estomatológica integral que incluye los tratamientos pulporradiculares. Se planteó como objetivo: describir los sustentos teóricos sobre el uso de las radiografías en las embarazadas necesitadas de tratamiento endodóntico. Se realizó una revisión bibliográfica teniendo en cuenta la literatura científica más actualizada sobre el tema. Se utilizaron 19 bibliografías. Para el desarrollo de la investigación se emplearon los métodos de análisis documental, analítico-sintético, análisis histórico-lógico. Se expusieron los efectos biológicos y clínicos de los rayos X, las etapas embrionarias y su susceptibilidad a las radiaciones, el uso de las radiografías en las embarazadas y las medidas de protección. Las radiografías no están contraindicadas en los tratamientos endodónticos en embarazadas, siendo recomendable en el segundo y tercer trimestre de gestación.

Palabras clave: Endodoncia; Embarazo y Salud Bucal; Radiografía Dental.

INTRODUCTION

Current knowledge and scientific advances have left behind the "era of tooth extraction" to focus on the prevention and preservation of all oral cavity structures in optimal health. The development of endodontics,

based on biological principles, enables dentists, aided by knowledge from other dental disciplines, to fulfill the desired goal of prevention and preservation.[1]

Endodontics is the branch of dentistry that deals with the etiology, diagnosis, and treatment of diseases of the dental pulp, root canals, and their apical complications. Radiology is an auxiliary means in endodontics, without which its practice would be impossible.[2]

Radiology is the science that deals with using X-rays to diagnose pathologies in hard or soft tissues in a specific area. This equipment generates artificial ionizing radiation. Radiographic examinations must be prescribed in strict accordance with international guidelines for radiation protection.[3]

Although X-rays have been redirected for medical purposes, there are situations in which their misuse can cause secondary damage from ionizing radiation, manifesting as tissue problems in both patients and operators. X-rays are a form of ionizing and penetrating radiation that affects living tissue through a process that causes stable atoms and molecules to become electrically unbalanced.[3,4]

According to studies conducted up to 2019, it is estimated that 21 % of the world's population undergoes dental radiological examinations as part of stomatological rehabilitation treatment and as a complementary measure following clinical diagnosis to confirm or rule out any pathology, a situation that includes pulp and root canal treatments.[5]

Oral radiographs are necessary to diagnose and monitor multiple oral diseases. However, due to the known stochastic effects of X-rays, it is essential to ensure patient protection.[6]

In Cuba, pregnant women are a priority group, and often, when examining them as part of the Maternal and Child Care Program, stomatologists find teeth with a fatal prognosis for the pulp but which can be preserved in the oral cavity through pulp treatment, which requires radiographic examinations. This can lead to three problems:

- The mother's fear that the radiation will affect the baby;
- The lack of knowledge among dentists, dental technicians, and students about radiation safety concepts can lead to overexposure or postponement of treatment until after delivery.
- The failure to optimize the radiographic technique by assessing the risks and benefits for the pregnant woman and the baby.

All of this can have adverse consequences for both the mother and the child, given that the child's oral health is linked to that of the mother.

Aware that textbooks have not addressed the subject of endodontics in pregnant women in-depth, the authors of this study consulted all the existing theoretical material on the topic to offer stomatology professionals a survey that presents the latest criteria on the use of X-rays during endodontic treatment in pregnant women. Therefore, the following scientific question was formulated: How safe is using X-rays in endodontic therapy during pregnancy?

The objective was to describe the theoretical basis for using X-rays in pregnant women requiring endodontic treatment

METHOD

A literature review was conducted, taking into account scientific literature on the subject from the last five years, using the leading information managers such as Scielo, Pubmed, and Google Academic, from which 35 bibliographies were obtained, selecting 19 of them according to their actual compliance with the academic criteria of Cuban stomatology. The source of information consisted of scientific review articles and original articles. The following methods were used during the research process: documentary analysis, analytical-synthetic analysis, and historical-logical analysis.

DEVELOPMENT

The human body continuously absorbs tiny amounts of natural ionizing radiation (cosmic rays, radioactive elements in the soil, in rooms) and artificial radiation (clocks, meters with luminous dials, television sets). It also absorbs radiation produced by residual radioactivity from nuclear exposure, one of the byproducts of which is strontium 90, which is stored in the bones in the same way as calcium; these amounts are currently considered harmless. However, interest has recently increased in artificial radiation and its effects on humanity.[7,8]

Radiation is how energy is propagated using electromagnetic waves that may or may not influence the structure of matter. According to the World Health Organization (WHO), there are two types of radiation: ionizing and non-ionizing. X-rays belong to the ionizing radiation group, while radio waves, microwaves, infrared rays, visible light, electricity, and even a small portion of ultraviolet rays correspond to non-ionizing radiation.[8,9]

Radiographic images are a crucial tool for the diagnosis and monitoring of oral diseases as well as for the evaluation of treatments. It has been known for several decades that X-rays can induce adverse biological effects, which are classified as stochastic and deterministic. Stochastic effects are related to mutations in

somatic or germ cells, which are potentially responsible for radio-induced cancers or hereditary disorders that appear after several years and have no dose threshold. Deterministic effects are those that, if a dose threshold is exceeded, produce a clinically detectable impact in the short term that requires justification of the need to use ionizing radiation in the procedure to ensure that the patient receives as low a dose as possible.[4,6,10] The latter is significant in the field of stomatology.

Although radiographic examinations are beneficial, they also have disadvantages, such as the inevitable amount of radiation to which patients are exposed, which, even at low doses, has the same harmful effect as higher exposure.[11]

According to the International Commission on Radiological Protection (ICRP), radiographic examinations should be performed by the "as low as reasonably achievable" principle, which means that the radiation dose should be reduced to a minimum and provide adequate diagnostic information. The examination scope and the radiation dose level for a patient should be adapted so that the necessary diagnostic information is obtained at the lowest possible radiation dose. Minimizing the risks associated with the use of ionizing radiation for diagnostic imaging is a significant public health issue, as ionizing radiation has sufficient energy to alter DNA potentially and can, therefore, cause radiation-induced cancer. This is especially important in children, who are more radiosensitive.[6,10,12]

It has been demonstrated that X-ray photons can cause chemical transformations within tissues, particularly the transformation of water into hydrogen peroxide, which is considered a cellular poison. Radiation can also alter the chemical composition of enzymes, inhibitors, and hormones, rendering them partially or ineffective.[11,13]

All absorbed energy radiation, however minimal, produces changes in cell structures, especially in the least differentiated and most karyokinetic cells, which are the most radiosensitive.[10]

According to Bergonie and Tribondeaux's law of cellular radiosensitivity, the following decreasing scale of cellular radiosensitivity currently applies:[6,8]

1. Embryonic (up to 90 days).
2. Genetic.
3. Blood and bone marrow (lymphocytes, erythrocytes, and myeloblasts).
4. Epithelial and endothelial.
5. Connective tissue.
6. Renal tubules.
7. Bone.
8. Nervous.
9. Muscular.

The above could explain the general and local manifestations of ionizing radiation. In the case of general manifestations, leukemia, anemia, sterility, and miscarriages, among others, have been described; local manifestations include dermatitis and alopecia in their acute and temporary forms.[13]

In practice, it can be accepted that the somatic effects produced by minute amounts of ionizing radiation can be repaired quickly. For this reason, the body allows or tolerates the repetition of small doses. However, when repeated doses exceed the elimination time (rest time without new exposures to return to normal), the effects accumulate, sometimes manifesting later in a local or general form, which is often irreparable. Another related factor is that individual differences also play a role in this regard, as some people may experience local reactions to a given amount of radiation while others do not.[12,13]

Therefore, dose optimization is essential, as ionizing radiation at any intensity can be potentially harmful. In the field of stomatology, radiographic techniques are constantly being developed to avoid repeated exposure or reduce the risk of ionizing radiation, which can occur if the equipment is not correctly positioned to shield the area to be irradiated and if the appropriate biosafety protocols are not followed by the patient, such as thyroid collars, lead aprons, and protective glasses, which are primarily intended to reduce the radiation received by the patient and provide better image quality.[13]

The sum of low-dose exposures has the same effect as a higher exposure, highlighting the importance of assessing the risk of ionizing radiation for diagnostic purposes.[11] According to international recommendations, the prescription of dental radiographic examinations should be individualized, justified, and optimized.[8]

About the genetic effects produced by ionizing radiation, there are several factors to consider:[8,10,14]

1. Part of the cell that has been damaged.

These may be genetic or functional elements. Gene degradation leads to irreversible mutations, which have been demonstrated experimentally in animals. Repeated exposure has a cumulative effect. Likewise, after many years, attention has been drawn to the danger of ionizing radiation to the gonads and the genetic modifications that repeated radiological examinations could cause. These modifications are recessive, although there is no risk of them becoming apparent until several generations have passed.

Studies of the offspring of Japanese women who survived the atomic bombings have revealed a sex ratio deviation, resulting in a deficit in the number of boys. This could be explained by the production of sex-linked lethal genes, i.e., genetic damage.

2. The nature and quantity of radiation absorbed

There is a definite relationship between the amount of radiation absorbed and the harmful effects, and this relationship is often directly proportional. Even small amounts of radiation, such as those used in radiodiagnostics, can have a harmful effect in the long term if they are repeated frequently. It is, therefore, necessary to protect oneself effectively against the effects of small daily doses of radiation.

3. The distribution of absorbed energy over time and space

The amount of energy absorbed is directly proportional to the magnitude of the radiation field. A large dose of X-rays, administered in a single session, can cause intense skin reactions. However, the same dose, when fractionated or administered over a long period, appears to have no biological effect, as the tissues can recover.

4. The reaction of the absorbing tissue.

The action of radiation is never immediately apparent. There is a latency period, so tissue changes do not appear until several days or even weeks later, even after very intense irradiation.

The reaction will always be determined by what is known as "radiation sensitivity," i.e., the sensitivity of cellular structures to ionization and oxidation processes.[9,11]

Regarding somatic and genetic effects, it is essential to remember that radiosensitivity is inversely proportional to age: (-) elderly-adult-adolescent-child-fetus during pregnancy (+).[10]

Studies conducted in adults have shown no permanent cellular effects associated with dental X-ray exposure at low doses of ionizing radiation (<10 mGy) and no evidence of an increased risk of cancer below 0,1 mGy. However, there are indications of a localized cytotoxic response in the irradiated tissue.[10,12]

Typical doses for each technique vary significantly between and within modalities, partly due to differences in how each method is administered. In general, single intraoral radiographs provide the lowest dose. The radiation used for diagnostic purposes in conventional oral radiology is very low compared to that used in other areas of medicine.[6]

Human prenatal development comprises three periods: pre-embryonic, embryonic, and fetal. The first is also called the egg or zygote period, which spans from fertilization to implantation in the uterine wall on the seventh or eighth day. The second is the organogenesis period, which spans from the second to the eighth week of intrauterine life. This is when most organs differentiate and develop, and the body's general shape is established. Due to this intense differentiation, the embryo is more susceptible to teratogenic agents, hence the importance of being especially cautious with pregnant women during this period when the embryo is highly vulnerable to radiation. The third period spans from the third month of intrauterine life to birth, when growth outpaces differentiation, and the fetus is less susceptible to teratogenic agents.[1]

However, teratogens may remain in the maternal tissues and become active only when the embryo's susceptibility increases during the second development period.[10] In the second stage, most teratogenic agents are very potent and cause many malformations. Still, the malformation type depends on which organ is most susceptible to teratogenic action. Each organ goes through its most vulnerable stage at the beginning of differentiation, and the body's various organs become susceptible one after the other.[10,14]

In the third stage of development, the differentiation of some organs, such as the cerebellum, cerebral cortex, and specific urogenital structures, continues. Therefore, some of these structures remain susceptible to the action of teratogenic factors until very late in pregnancy.[15]

Radiological diagnosis in dentistry is considered safe in pregnant women, according to studies conducted by the American Dental Association. Dental radiographic examination requires very low radiation exposure, so the risk of harmful effects is extremely low. International organizations do not recommend modifying the use of dental radiography in pregnant women. The dentist will have to adequately protect the abdomen and neck of the pregnant woman by using a lead apron. Digital X-rays are highly recommended as they reduce the amount of radiation required and provide an instant, clearer image.[15]

The estimated fetal exposure during an intraoral X-ray is equivalent to 0,0001 rad, with the accepted safe radiation dose during pregnancy being 5 rad.[15,16]

Most biological responses to X-rays occur in the first two weeks of pregnancy when the mother is unaware of her condition. Depending on the dose of radiation absorbed, a miscarriage may occur during these weeks, the onset of malignant disease in childhood if exposure occurs in the last 3 months of pregnancy, or a congenital anomaly at any stage of development. However, for any of these events to happen, the effective dose to the fetus must exceed 100 mSv, which is difficult to achieve in dental X-rays and cone beam computed tomography (CBCT), where doses do not exceed 134 μSv (0,134 mSv). Studies of absorbed doses in utero have shown that

the average dose in the most common procedures is 0,4–1 μSv per X-ray.[8,16]

No clinical studies demonstrate an association between the low doses of radiation used in oral diagnosis and genetic mutations or other harm to the patient or operator, nor can it be assured that they are absolutely harmless.[14]

According to Leonardo, pregnancy is not a contraindication to endodontic treatment, as ionizing radiation can be made harmless as long as the basic protection requirements are met: distance, shielding, and exposure time. However, as few X-rays as possible should be taken, always with the essential protection of a lead apron.[14]

According to some authors, using lead shields in dental radiography during pregnancy is ambiguous, and practices vary. Several studies recommend using lead aprons and thyroid collars to minimize fetal exposure. However, dental radiography involves the lowest risk of radiation to the fetus of all diagnostic radiography procedures, leading to the conclusion that X-ray shields for the uterus are unnecessary.[17,18]

European guidelines on radiation protection in dental radiology state that there are no contraindications preventing pregnant women or women who may be pregnant from undergoing dental radiography when clinically justified. Furthermore, they also consider that using a lead apron in dental radiography is unnecessary.[19]

Considering the above analysis, the authors of this study consider that compliance with biosafety standards in radiology is mandatory, including the use of lead aprons for all patients, especially pregnant women, even though the radiation produced in dental X-rays is negligible.

Several authors believe that the ideal time for endodontic treatment in pregnant women is during the second trimester of pregnancy, as the pregnancy is already established, nausea in response to specific tastes and smells has already been overcome, the pregnant woman is psychologically better, and the possibility of miscarriage at this stage is very remote since if the patient is destined to miscarry, it is more likely to occur during the first trimester.[17]

There are also no contraindications for treatment during the third trimester of pregnancy, except for the discomfort of a prolonged session, and, depending on the case, only emergency treatment should be performed, and a more appropriate time after delivery should be waited for. However, many mothers prefer complete dental treatment before giving birth, knowing how difficult it will be to keep a dental appointment after the baby is born.[18,19]

The least recommended period for endodontic procedures in pregnant women appears to be the first trimester. Emergency care should be provided in this phase, and treatment should be postponed.[17]

When performing endodontic treatment on a patient of childbearing age, it is essential to inquire about the possibility of pregnancy to avoid exposing her to unnecessary ionizing radiation that could act as a teratogen.[19]

For these reasons, the authors of this study recommend not performing endodontic treatment on pregnant women during the embryonic period, when organ differentiation occurs, and the embryo is most susceptible to teratogenic agents. The appointment should be postponed until the end of this period, and a lead apron should always be used.

CONCLUSIONS

Most authors agree that the most recommended periods for using X-rays in endodontic treatment are the second and third trimesters of pregnancy. The use of protective measures and the performance of the minimum number of X-rays in all patients, especially pregnant women, is an essential requirement.

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