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Track Density and uranium concentration Measurements for Male and Female Teeth (10-50) year in Al – Anbar Governorate (Al- Ramady) using PM- 355 Detector

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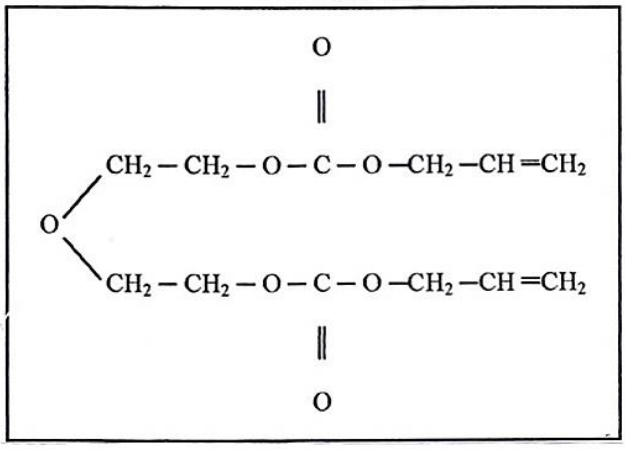
Abstract

Track density and uranium concentration were measured for eighteen samples in male and femal teeth , ages between (10-50) year were taken using particular solid – state nuclear track detectors called PM-355 with weight (0.5) gm and (1.5)mm thickness in Al- Ramady. ($SSNTD_s$) using fission tracks that caused by the bombardment of uranium with thermal neutrons from (^{241}Am –Be) neutron source that has (5x 10^3n. cm^{-2} .s^{-2}) flux. The calculated results compared with standard samples, then discussed on the basis of physical changes occurring on the microscopic level in the PM - 355 due to irradiation. The results showed that the average value for uranium concentration to male equal (0.0426ppm) and female (0.0511ppm) .These results seems to be in high level compared with previous studies.

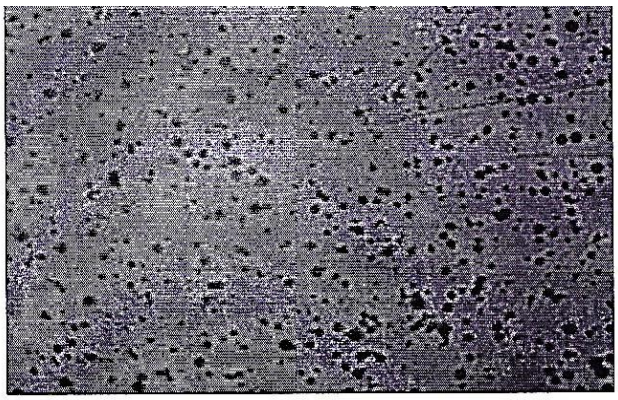
Keywords: *Teeth radiation, Dental anatomy, Uranium concentration.*

1. Introduction

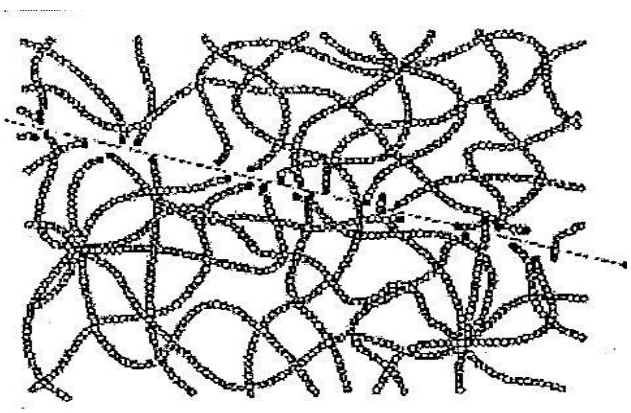
More sensitive ($SSNTD_s$) used for recording fission fragment tracks were manufactured in the eighties and they commercially available as PM-355, PM-500, PM-600 plastics. The particular PM- 355 is of explicit concern, finding assorted applications in physical and technological sciences[1], its chemical composition $C_{12}H_{18}O_7$ called polycarbonate of allyldiglycol, as in figure down [2].



SSNTD's record the passage of charged particles permanently and the region around the charged particles path is more re-atctive to chemical etching agents, which makes Possible to rival the particle track and observe them at optical microscopes as appear in the following figure.



The etched tracks formed by the breaking of the long polymer chains to short chains when irradiated , as shown in the following figure [3,4,5].



Most people received relatively small amounts of artificial radiation, but few get many thousand times the amount

received from natural sources. The variability is generally greater for man- made sources than for natural ones;it can be controlled readily than most natural ones through exposure to external irradiation [6].

The technique of measuring the number of particle by observing their track in certain organic or inorganic materials has been used for the study of phenomena in such diverse fields as geology, osterophysics, and nuclear physics [7].

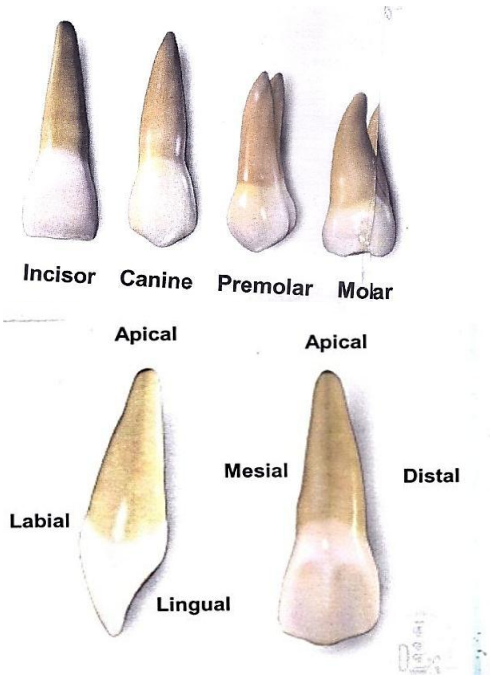
The major emphasis in this research is on the use of plastic track detectors for the dosimetry of thermal neutrons, usually requires the use of "Converter screen" to generate charged particles which can leave etc hable tracks in the plastic through interactions with the constituent nuclei of the detector material itself (the polymer).

2. Dental Anatomy and physiology

A tooth is made up of the three elements water, organic materials and inorganic materials. There are two types of teeth:-

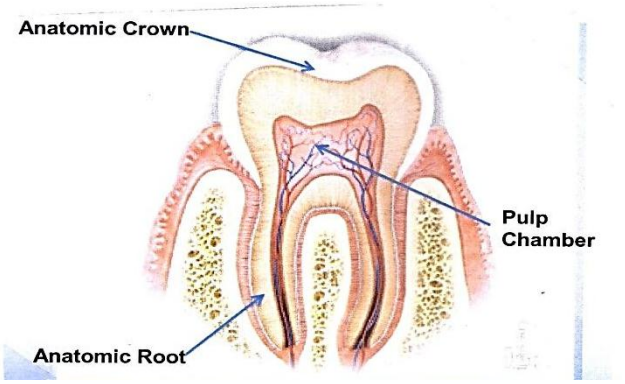
1- Primer (deciduous) which consist of twenty teeth and begin to form during the first trimester of pregnancy, typically begin erupting around six months. Most children have a complete primary dentition by three years of age.
2- Secondary (permanent), which consist of thirty two teeth in most cases and begin to erupt around six years of age. Most permanent teeth have erupted by age twelve.
3- Wisdom teeth are the exception; often do not appear until late teens or early twenty years.

The teeth classified as; Incisors(central and lateral), Canines (cuspids), Premolars (bicuspids)and Molars as shown in the following figure [8].



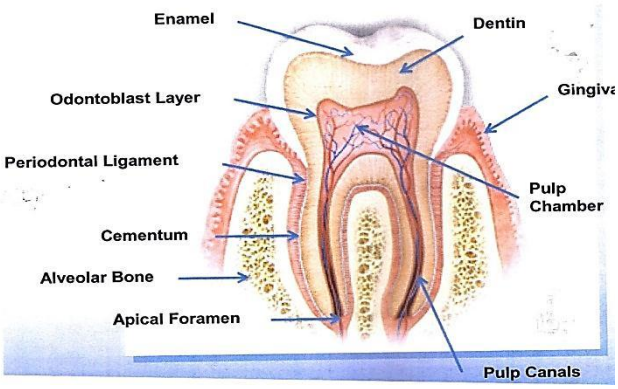
The tooth surfaces types; Apical, Labial, lingual, Distal, Mesial and Incisal as seem in figure down.

There are three parts of tooth; Anatomic crown, Anatomic Root and Pulp chamber as shown in the following figure [9].



Two types in dental tissue[10]

1- Hard tissue such as; Enamel, Dentin, Cementum and Alveolar Bone.
2- Soft tissue such as; Gingive , pulp chamber , periodontal ligament and adontoblast layer. As shown in figure down.



3. Materials and Methods

1- Eighteen samples of teeth distributed in Al – Ramady city were taken from location of study, with weight (0.5gm.), (1.5mm) thickness and (1mm) radius. The samples cleaned and dried in an oven at (60°C) for (15) hour [11].
2- The pellets (teeth samples) were covered with PM-355 detector, then putting in a plate of paraffin wax at a distance (5cm.) from the neutron source (^{241}Am-Be), with flux of thermal neutron.
3- After irradiation for seven days, the PM-355 removed and etched in a (6.25N) aqueous solution of (NaoH) maintained at(60°C) for (15) hour, then the detectors were rinsed with distilled water and dried in air[12].
4- The tracks recorded in PM-355 detectors counted by using optical microscope at a magnification of 400*x*5
5- The density of the tracks(ρ) in the detectors was calculated according to the following:

$$\rho = \frac{N_{av.}}{A} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

ρ : Fission track density (track/ mm^2)
N_{av}: Average number of total tracks.
A: Area of field view.

6- Fission track technique was used for determination uranium concentration in the teeth samples by making a comparison between track densities registered on the detectors of the sample and that of the standard sample. The uranium content in the unknown samples was determined by using the following formula [13].

$$C_x = C_s(\rho_x / \rho_s) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where C_s, C_x : Uranium concentration (ppm) for standard and sample respectively.

ρ_s,ρ_x : Track density (track / mm^2) for standard and unknown sample respectively.

4. Results and Discussion

1- Table (1) and Table (2) shows the track density, uranium concentration (for male and female) teeth samples in the range (10-50) years. From these data, the calculated average value to uranium concentration for male equal (0.0426 ppm) and (0.0511ppm) for female.
2- The relationship between age& track/mm^2, age & uranium concentration , track/mm^2& uranium concentration were drawn from the obtained results and the mathematical equations were calculated as shown in figures (1-3) for male , (4-6) for female.
3- The results showed the maximum value to uranium concentration in (50) years for female was (0.0852ppm) and (0.0826ppm) in male at the same age, while the minimum value was (0.0165ppm) for (10) years male and (0.0170ppm) for female at the same age.
4- The uranium levels for male and female in this study seems high values comprised with normal values due to acceptable American system [14].
5- In general female loses calcium due to repeated delivery, osteoporosis, and menopause and for these reasons female more affected to radiation.

Table (1): Uranium concentration for male teeth samples

Age Year	Track density Track/ mm^2	Uranium concentration (ppm)
10	12.696	0.0165
15	19.044	0.0177
20	25.391	0.0236
25	31,739	0.0295
30	38.087	0.0340
35	44.435	0.0440
40	50.783	0.0610
45	57.130	0.0744
50	63.478	0.0826

The average value of uranium concentration equal(0.0426ppm)

Table(2): Uranium concentration for female teeth samples

Age Year	Track density Track/ mm^2	Uranium concentration (ppm)
10	13.114	0.0170
15	19.670	0.0256
20	26.227	0.0341
25	32.784	0.0426
30	39.341	0.0511
35	45.898	0.0597
40	52.455	0.0682
45	59.011	0.0767
50	65.568	0.0852

The average value of uranium concentration equal(0.0511ppm)

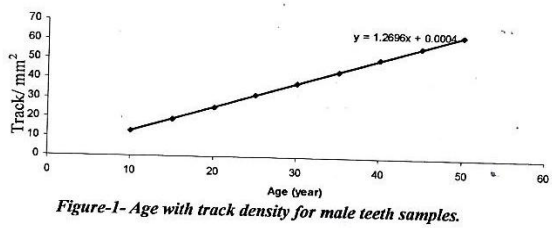


Figure-1- Age with track density for male teeth samples.

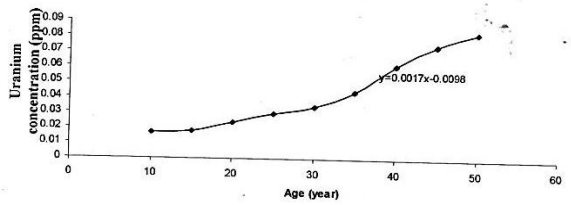


Figure-2- Age with uranium concentration for male teeth.

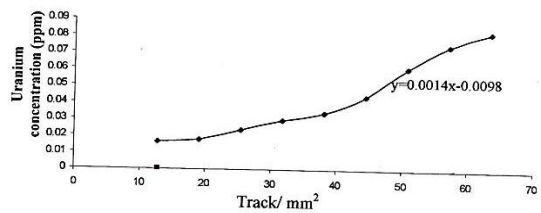


Figure-3- Track density with uranium concentration for male.

Conclusions

1- Radiation of the head and neck may cause osteoradionecrosis the jaw, or death of the cells in the bones according to the University of Texas MD and Anderson cancer center.
2- Diseased teeth should be removed before radiation therapy because removal of the teeth after radiation can cause infections in the jaw.

3- Atypical application of (SSNTDs) in the medical and radiobiological fields are; the filtration of malignant cells in the blood, the measurement of α- emitters in the environment, and the distribution of lead in the teeth and bones.
4- The cross- linking might take place due to the free radical (recombination and the results indicated that the changes in the polymer properties depend on whether cross- linking or degradiation dominates during the irradiation. The free radicals formed due to scission are chemically active and can be used in some chemical reaction that leads to the cross-linking mechanism [15].

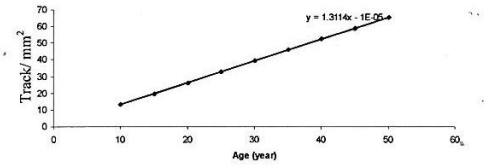


Figure-4- Age with track density for female teeth samples.

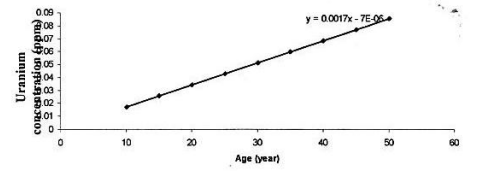


Figure-5- Age with uranium concentration for female teeth.

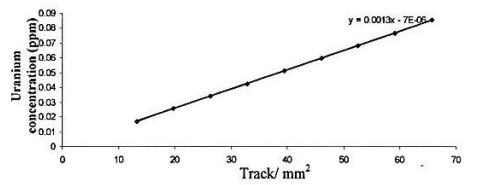


Figure-6- Track density with uranium concentration for female.

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