

Plasma Needles on the Teeth Structure and Compressibility

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Abstract

The aim from this research is to prove not affected the teeth of both damage macroscopic and the internal structure of teeth (compressibility). The teeth were collected from (Al karama dental specialized) in Baghdad, directly after uprooted from the patient's mouth. It was in table by the material (normal saline, sodium chloride, 0.9%), according to instructions of dental disease specialist. It was regarded as a natural model replica. It has been conducted two tests on some samples: studying the macroscopic damage for teeth and studying the influence compressibility for teeth. The design of generation argon plasma needle system, this system works on production Non- thermal plasma at atmospheric pressure, where used simples electronics constructions and cost low, it has power to generate high electric field on electrodes enough to ionize different gases and flow in atmospheric pressure. The device jet plasma needle used surely from no events any macroscopic or mechanical damage in build inside teeth (compressibility), where it applied on some teeth sample at time double treatment time, then teeth check consequently favorableness result, where load force of tooth without plasma exposure was 1.74kN while load force of tooth with plasma exposure was 1.824kN. Studying the macroscopic damage for teeth, the mentioned area were not affected with damage or change colors, therefore in effecting the teeth with any negative results during plasma needle process.

Key Words: *teeth, plasma needle, strain, necrosis*

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Introduction

The plasma needle is a type of non-thermal atmospheric glow discharge, it has a single electrode configuration and is operate by different noble gas (He-Ar), important properties of this type of plasma are that it operate at near room temperature, the plasma does not cause any thermal damage to articles it comes in contact with. This characteristic was open up the possibility to use this plasma for treatment of the heat sensitive materials. Atmospheric pressure discharge plasma is of great interest because of their low costs and simplified operation [1]. It uses in Several applications such as treatment of living cells, bacteria in activation, tooth bleaching and air purification. In recent times, biological and biomedical applications of plasma are of great interest. Plasma sources are employed for bacterial inactivation and tissue sterilization, decontamination of medical instruments, surface modification of implantable biomaterials etc [2]. Among the various plasma sources reported, Ar plasma jet is very effective for the sterilization of micro-organism. It was observed that Ar plasma source showed stronger emission intensity of reactive radicals and better killing effect than the He plasma source [3].

Teeth are the only hard non-shedding surfaces in the body. The tooth is composed of four tissues: enamel, dentine, cementum and pulp. Enamel is the hardest and most mineralized structure in the human body. Normally it is the only part of the tooth exposed to the environment [4,5]. Enamel is primarily composed of minerals (96%), water and organic material. The primary mineral of enamel is hydroxyapatite, $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$. Enamel is hard but also very brittle [6]. The enamel is supported by its underlying dentine. Dentine is a protective layer that supports the crown and protects the pulp. It is a mineralized connective tissue with bundles of collagen filaments surrounded by mineral crystals. Dentin contains dentinal tubules which are micro-canals radiating outwards. The dentine is porous and made up of inorganic material (70%), organic material (20%), and water (10%) [7]. The dentine is softer than enamel. Because of that the dentin decays faster than the enamel.

This rapid decay leads to severe cavities if not treated properly. Cementum is a substance found in the root covering the dentine. It is softer than either enamel or dentin. The composition of cementum is almost similar to bone. The difference is that cementum lacks vascularization. The cementum is made up of inorganic material (45%) (mainly hydroxyapatite), organic material (33%) (mainly collagen) and water (22%) [6].

The pulp contains blood vessels and nerves. The blood and nerve cells are supplied from the tissues of the jaw via the root. The nerves detect pain and the blood vessels nourish the dentine [4].

Experiment setup

Plasma needle designed with diameter 1mm from interior, this needle constitutes cylindrical tube made from glass material with length 100mm interior this glass tube, put other cylindrical tube made from iron material with external diameter 2.7 mm, this tube connect to anode from high voltage power supply about 9.6kV peak to peak, applied power was lasting of electrical discharge which calculated from simultaneous values of voltage and current about 15 watt and applied frequency 33kHz, it through pass argon gas where discharge between electrode and space through needle hole where plasma generation outside from hole.



(Fig .1): Plasma needle

Methods

Taken the teeth from (Al karama dental specialized) in Baghdad, directly after uprooted from the patient's mouth. It was in table by the material (normal saline, sodium chloride, 0.9%), according to specialist dental disease instructions. It was regarded as a natural model replica. It has been conducted two tests on some samples: studying the macroscopic damage for teeth and studying the influence compressibility for teeth.

Results and discussion

To prove not affected the teeth of both: The first: the exterior is (necrosis, change colors, or any damage macroscopic), and the Second: the internal structure of teeth (compressibility).

After exposure to the plasma needle during treatment according to the terms of the experiment which has by killing bacteria, ($f=15\text{kHz}$), ($V=1750\text{ volt}$), ($t=40\text{sec}$), ($d=2.5\text{cm}$), ($\text{flow}=3\text{l/min}$).

It has been conducted two tests on some samples:

1. The macroscopic damage for teeth

Plasma Needle has been shed on the sample shown in Figure (2), at different times (30, 60, 90) sec. more than the time that needed to kill bacteria formed in the mouth and on the surface of the tongue and teeth depending on the conditions of the experiment.

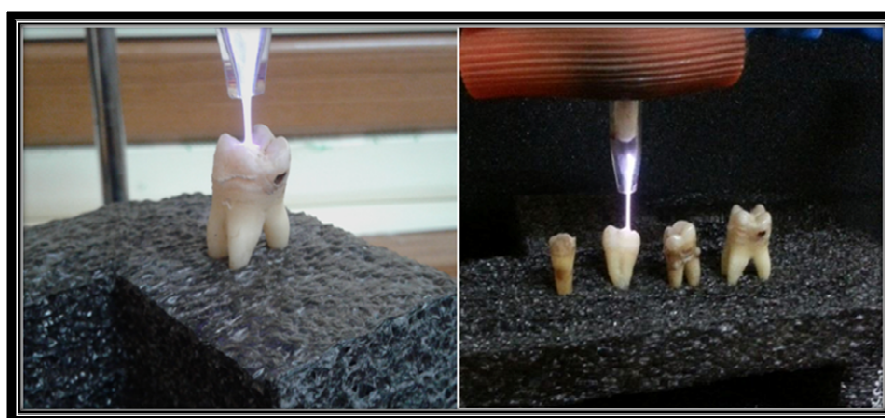


Fig.(2): sample of teeth

The sample was put under microscope equipped with camera to pick images with magnification factor 1/40, as shown in figure (3). Notice that the mentioned area were not affected with damage or change colors, therefore in effecting the teeth with any negative results during plasma needle process in spite of using different times up to double elapsed time for processing [8].



Fig.(3): An enlarged image of the tooth, (a) Before exposure to plasma needle, (b) After exposure to plasma needle in time 30s, (c) After exposure to plasma needle in time 60s, (d) After exposure to plasma needle in time 90s.

2 .The influence compressibility for teeth

It is necessary to study the effect of the plasma needle on the internal structure of the teeth. ,and to make sure that there are no mechanical damage to the teeth after exposure to a plasma needle during processing. The two taken samples were identical in terms of the patient's sex, age, and type of teeth. The first sample: no exposure to any treatment of a plasma needle and considered (Control). Second sample: exposed to the plasma needle in the same previous conditions that have been by the killed bacteria, but for a time equal to twice the time of the experiment 90s. Took two samples was an examination of compressibility, and the result was as illustrated in Figure (4).

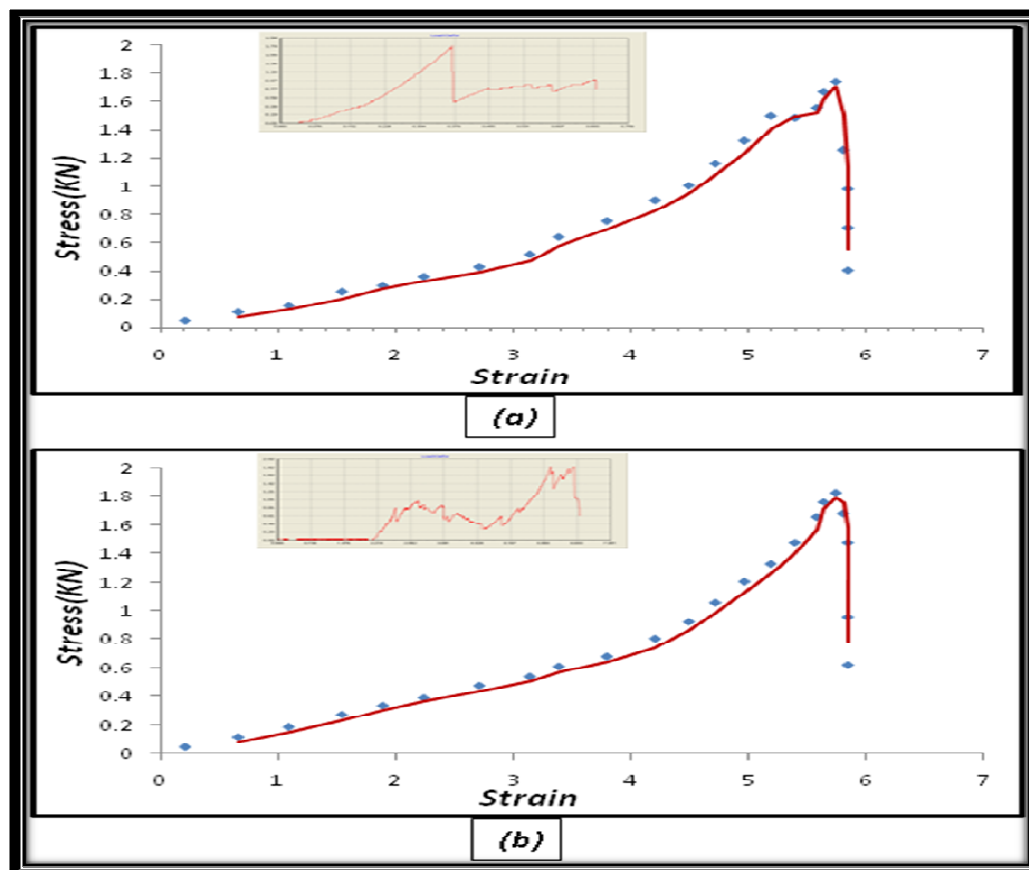


Fig.(4): the relationship between the stress as a function of strain, (a) not been exposed to any treatment, (b) with exposed to plasma needle.

From figure (4a) note that maximum load of the sample that have not been exposed to any treatment is (1.74 KN). The sample shown in Figure (4b) that have been exposed to the plasma needle and the same treatment conditions with double time, note that it has endured (1.82 KN)[9]

This shows that the plasma needle did not adversely affect the teeth compression, and thus demonstrated that the plasma torch is effective against bacteria without causing any negative factors[9,10]also in bio-decontamination by plasma, it is crucial to understand the role of various mechanisms involved. The significant mechanisms depend on the plasma composition (gas), temperature, treated microorganisms and the environment (air, water, surfaces, etc.) [11,12].

Conclusion

The plasma generator was built using only general purpose component, that are ready available, the unit is easy to set up and operate .A non-thermal plasma torch was built to operate at atmospheric pressure. Studying the macroscopic damage for teeth, the mentioned area were not affected with damage or change colors, therefore in effecting the teeth with any negative results during plasma needle process in spite of using different times up to double elapsed time for processing.

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