

## THE EFFECT OF THE MICROWAVE ON THE OPEN WOUNDS HEALING IN RATS

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### ABSTRACT

The present study was designed to investigate the effect of 9.5GHz and 11.5 GHz of microwave open wounds healing, thirty adult rats males were used. The animals were divided into three groups of (10) rats each group. 2 cm wound were done surgically in all rats in thigh region in gluteal, under effect of 5 mg/kg B.W. xylazine and 50 mg/kg B.W. ketamine Hcl. The first group exposure into 9.5GHz and second group exposure into 11, 5GHz, 2 hours daily for 10 days and other 10 rats as control. In this study revealed to efficiency microwave on wound healing through the clinical and histopathological changes in the 5 and 10 days intervals from began wound healing. Results showed that the histopathological change of control group was appearing epithelization, present inflammatory cells. In 9.5 GHz group noted increase in thickness of dermis and epidermis. Also increase in fibroblast cells to close the gap of wound. But the 11.5GHz group the process was an arrangement system and occur delay healing, from these results, the microwave effect on wound healing according the exposure of frequency of GHz.

### KEY WORDS

*Microwave, wound healing, histopathological changes, tissues*

### INTRODUCTION

The use of microwave radiation for healing is now common in many fields, it is also many application in medical fields especially in clinical cancer therapy hypothermia [1]

Continuous microwave (CM) has already been shown to be effective in treating various pathologic states. Electron irradiation has become readily available for use in radiotherapy, [2]. During the last few decades, there have been substantial improvements in wound healing or cancer therapy, which is currently an important part of several disease treatments [3].

Microwave therapy consists of exposure of certain areas of the skin to low intensity MW any one of several sites of application appears to be effective. Good results have been reported after irradiating various locations over the internal area [4].

Wound healing is a complex and dynamic process with the wound environment changing with the changing health status of the individual. The

knowledge of the physiology of the normal wound healing trajectory through the phases of hemostasis, inflammation, [5] granulation and maturation provides a framework for an understanding of the basic principles of wound healing. Through this understanding the health care professional can develop the skills required to care for a wound and the body can be assisted in the complex task of tissue repair [6].

The aim of this trial was to study the curative effect of this new physical method on the course of postoperative inflammatory processes in wound healing.

### MATERIALS AND METHODS

Thirty adult rats male aged 10-12 weeks, body weight 250-300 gram were used in this study. Rats were housed at the college of veterinary medicine university, given food and water.

All rats were anesthetized with intramuscular administration of 5 mg/kg/BW xylazine and 50 mg/kg BW ketamine. The area of the gluteal region was shaved and cleaned, and then a longitudinal incision in skin was made by sharp discective involving epidermis, dermis and hypodermis about 2 cm and then left for 24 hours under the same environmental conditions. These rats were divided into three groups randomly of ten rats for each.

After 24 hrs of wounding the rats in treated group with microwave 9.5GHz this exposure for 2 hrs daily for 10 days directly after collection the rats in pox [fig1 and 2] .and other group treated exposure into 11.5GHz ,2 hrs daily for 10 days . but other 10 rats as a control without exposure of microwave.

The histopathological sections prepared from the wounds were examined in 5 and 10 days intervals by microscopic to evaluate the degree of healing with changes.



Figure (1): show the rats exposure the MW in the pox



Figure (2): Show the continuous exposure of rats for MW for 2 hours

## RESULTS

Clinical study, the result revealed the followings; In control group, the wounds appeared swelling after 48 hours and showed the granulation tissue after 3 weeks.

In 9.5GHz group , showed decrease the length of wounds and accelerating wound healing without complications as well as granulation formation in minimal amount, healing occur on 10 days.

In 11.5GHz group, showed dryness of the wound healing process specially in margin of wound, the wound healing occur on 30 days.

#### **Histopathological study:**

In control group, on 5 days after induce wounding the epithelization occur through the inflammatory cells such as fibroblast and increase collagen fiber formation (Fig-3). On 10 days, appear granulation tissue as well as collagen fibers and the line of wound was still (Fig-4).

The treated group with 9.5GHz, after 5 days from wounding, the inflammatory process, showed increase thickness of dermis and number of the fibroblast to closed the gap, the line of wound was disappear and increase epithelization according the activity of the inflammatory process (Fig-5). On 10 days, showed the decrease the fibroblast and increase the collagen fibers, increase thickness the dermis and epidermis and completely disappear of line on wound. (Fig-6).

The treated group with 11.5GHz, after 5 days showed increase dermis and fibroblast cells continuous about 2 weeks, the prominent fiber in this group is fibrosis, but the line of this wound as a began (Fig-7). On 10 days, showed the increase collagen fiber, inflammatory cells formation and in complete arrangement system about healing process and granulation tissue (Fig-8).

#### **DISCUSSION**

The inflammatory processes in natural tissue occur in the normal time, when the process is good due to no complications in any types.

The cellular activity in wounds changes dramatically in the first week post acute injury, the initial fibrin, fibronectin matrix is heavily populated by inflammation cells, whereas the fibroblast and endothelial cells will predominate as healing progresses that is agreement with [6].

In control group, the healing of wounds occur after acute injury, reconstruction of injured epithelium is crucial for re-establishment of the injured epithelium begins almost immediately after wounding, incisional skin injuries, with minimal epithelial gap are typically re-epithelialized within 24-48 hours after initial injury, that agree with [7].

The role of cytokines, immunomodulatory factors it produces, as well as insulin-like growth factor-1, transforming growth factors-B, to activity inflammatory process, that is agree with [8 and 9].

Accelerating wound healing is an important goal in general surgical practice, more importantly wound healing with minimal scar or granulation tissue formation is highly advocated in plastic surgery, acceleration wound healing by the use of microwave and magnetic field could a place in the field of surgery since granulation or scar tissue formation or delay healing is allegedly reported according [10].

In the present study the device was used for the generation of microwave is assembled and tested locally to transmit 9.5 and 11.5 GHz and affect the microwave on wound healing [11].

When the tissue exposure to 0.5 mill-watts for cm<sup>2</sup> doesn't any changes side effect, but the high doses and accumulation doses may be lead to side effect on tissue [7].

The interaction between the tissue and microwave occur through mechanical effect (thermal & non-thermal), and the advantages for these effect appear by processing healing of wounds. [6].

On the 9.5 GHz exposure 2 hours daily for 10 days, the thermal and non-thermal effect is very clear about the process healing in this group according the time and frequency of radiation, accelerating fibroblast proliferation and mature the collagen fibers, all these process occur due to activated the growth factor and cytokine and release PGF2a that agreement with [9] and disagreement with [11].

All interaction the microwave with tissue occur due to converted the Energy into temperature, but in some times the effect non-thermal about electrical filed, that appear in 11.5GHz lead to changes in cellular protein and lead to delay healing, that disagreement with [12]. Because these authors delivered irradiation 7 days before wounding, while in this investigation, the wounds were inflicted on normal tissue after wounding at 24 hours with microwave, that disagree [13].

The advance of wound healing in 9.5 GHz lead to accelerating the histologic changes that occur after irradiation treatment, a thorough knowledge of the treatment for these wounds and this dose 9.5GHz is very important and enhance metabolic path-ways by

several difference mechanisms ,including activation of the previously partially inactivated enzymes such as adenosine tirphosphatase (ATPase).induction of reactive oxygen ,stimulation of calcium influx and mitosis rate and augmented formation of messenger ribonucleic acid (mRNA) and protein secretion .Also

the microwave enhance cell proliferation and motility of fibroblast and keratinocytes . As well as activated skin circulation and induction angiogenesis and then successful closure of the wound, that agreement with [12].

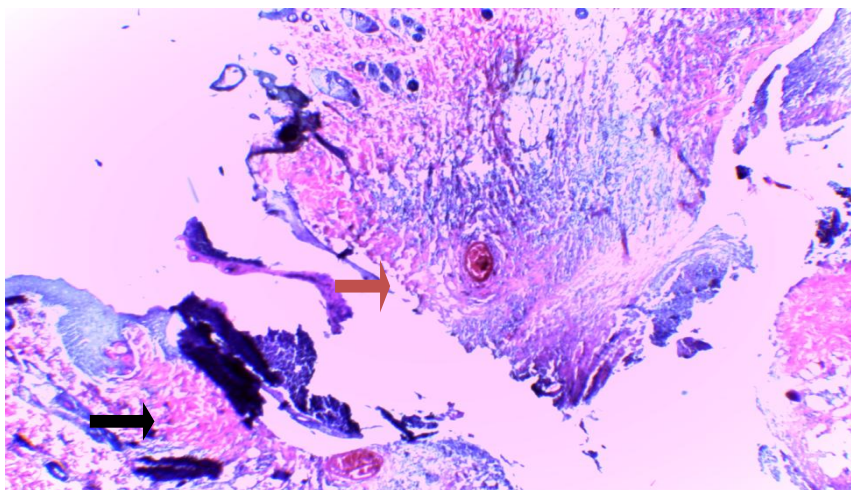




Figure (3): transvers histopathological section in the skin of rat in 5 days after wound, in control group showed the fibroblast cells,  inflammatory cells   
(H&E stains 100 X)

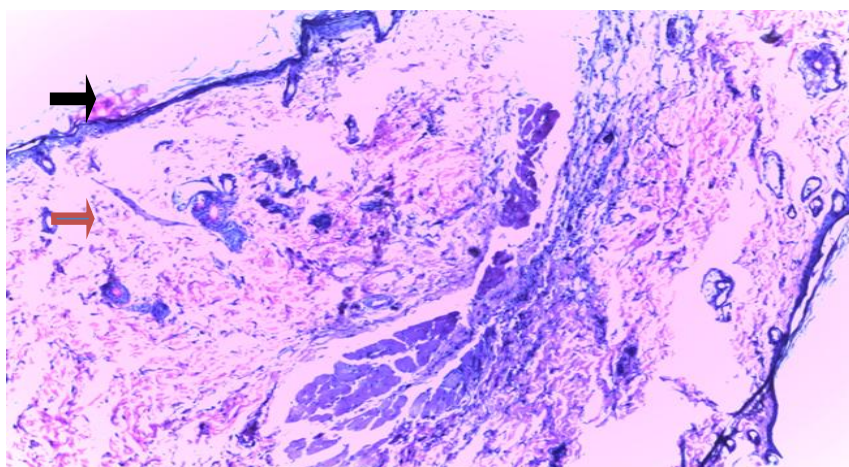




Figure (4): transvers histopathological section in the skin of rat in 10 days after wound, in control group showed the granulation tissue formation,  collagen fibers   
(H&E stains 100 X)

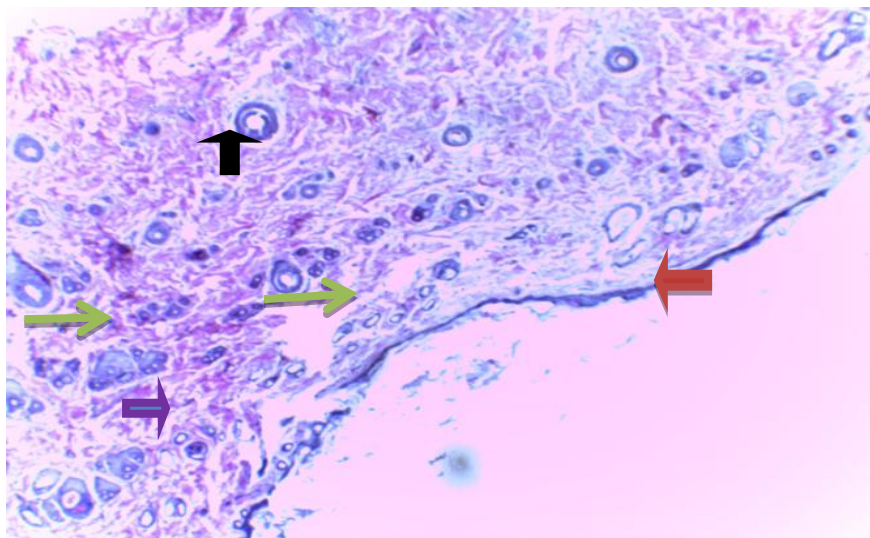


Figure (5): transvers histopathological section in the skin of rat on 5 days after wound, in 9.5GHz group showed the increase thickness of epidermis , follicle hair ↑  
Increase collagen fibers → fibroblast → (H&E stains 100 X)

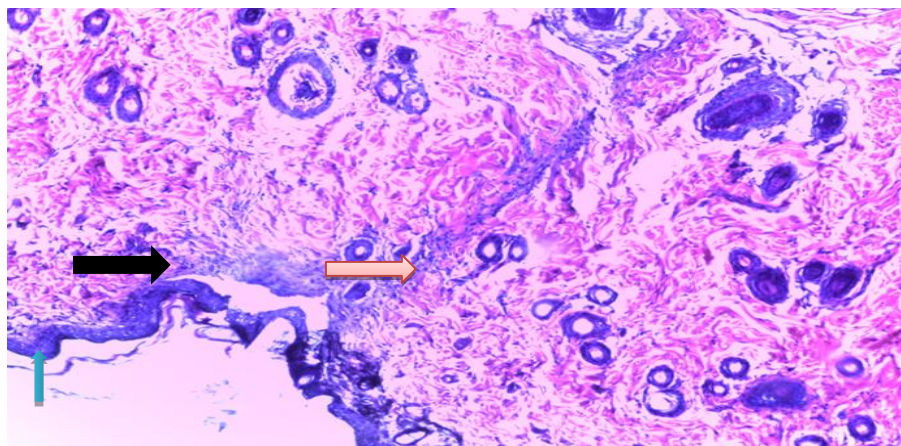


Figure (6): transvers histopathological section in the skin of rat on 10 days after wound, in 9.5GHz group showed the increase thickness of epidermis , nitrophil →  
Increase collagen fibers → (H&E stains 100 X)

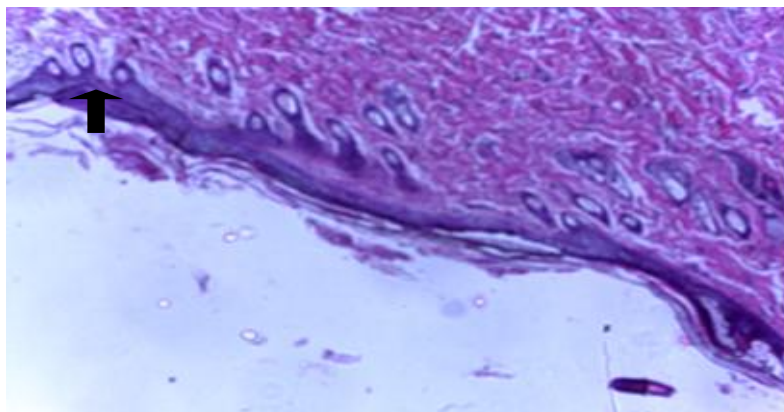


Figure (7): transvers histopathological section in the skin of rat on 5 days after wound, in 11.5GHz group showed the very simple thickness of epidermis , ↑ (H&E stains 100 X)

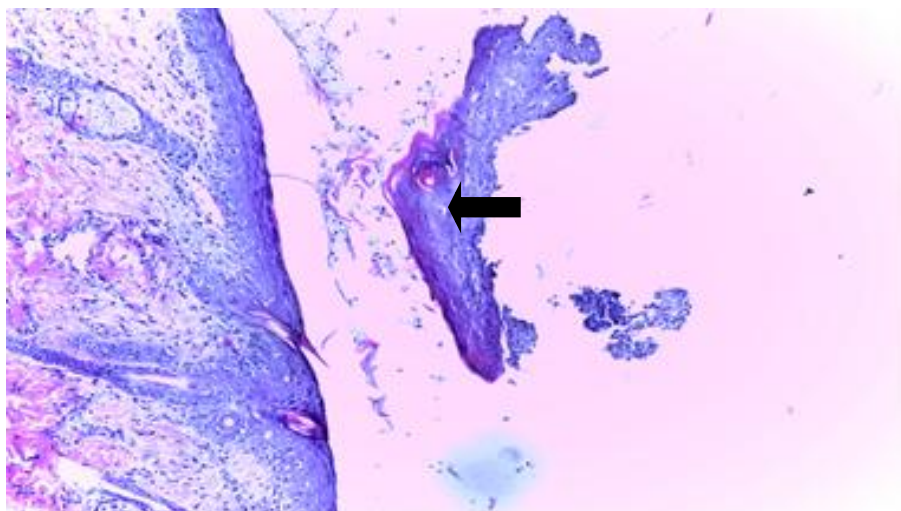


Figure (8): Transvers histopathological section in the skin of rat on 10 days after wound, in 11.5GHz group showed the scar tissues, (H&E stains 100 X)

#### REFERENCES

1. Nabil, T.M; Mona,A.A. and Asma,F.S.(2003). Effect of microwave heating on the thermal states of biological tissues. African J.of Biotechnology ,2(11),: 453-459.
2. Liu.J.and Xu,,L. (2000). Boundary information based diagnostics on the thermal states of the biological bodies. Int.J. Heat Mass Transfer, 43:2827-2939.
3. Kokoschinegy,p.(1981)Magnetic substances and externally applied field uber die wirksameit statistcher magnetischer felder-Dtsch,AKUP,6:135-141.
4. Maria,S.D;Dibo,d and Frab,N.(2007).Microwave applications .Braz.Dent.J.;18(3),:208-214.
5. Wang,Q.D.;Dickson.G.R and Carr,K.E.(1994). Electron irradiation slows down wound repair in rats skin: a morphological investigation .Br.J.Dermatol; 130:551-560.
6. Schaffer,M;Weimer,W;Wider,S. and Becker,H.(2002). .Differential expersion of inflammatory mediators in radiation –impaired wound healing .J.surg.Res. ; 107:93-100.
7. Mendelsohn,F.A.;Divino,C.M.and Kerstion ,M.D.(2002). Care after radiation therapy ADV skin wound care; 15(216):218-224.
8. Monaco,J.L and Thomas,L.W. (2003). A cute wound healing an overview .Clin. plasic surg. . 30:1-12.
9. Lawrence, W.T.(1998). Physiology of the acute wound .Clin.Plas. Surg.; 3:321-40.
10. Nanney, L.B.; Magid, M and Stoscheck,C.M(1998). Comparison of epidermal growth factor binding and receptor distribution in normal tissue epidermal .J.Invest.Dermal.83; 385-93.
11. Madden,J.W.and Peacock,J.R.(1992).Study on the biology of collagen during of rats .Surg.;64:288-94.
12. McCartney,F.N and Mizel,D.W.(1988). Transforming growth –B.as an immunoregulatory molecule .FASEB.J;2:a873.
13. Witte,M.B. and Barbutl, A,A. (1997).Wound healing :general principle of wound healing .surg.clin, N,Am.;77:509-28.

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