Denture Disinfection by Microwave at Different Times and Powers

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ABSTRACT

Aims: To evaluate the best microwave power and the proper time that disinfect acrylic resin denture base material. **Methodology:** Fifty five samples were prepared from heat cured acrylic resin(10mmx10mmx2mm) then immersed in glass flask containing brain heart broth and inculated with swabs from patients wearing complete denture divided into: negative control group (untreated), positive control group immersed in 0.02% sodium hypochlorite for 8 hours, and nine groups of different microwave disinfection settings (different powers and times),then immersed in sterile BHI broth individually and diluted up to 10^{-4} and 0.01ml plated in blood agar and Sabouraud's dextrose agar and CFU/ml were collected. **Results:** analysis of the data showed a significant difference between tested groups. **Conclusions:** microwave disinfection at 900W and 540W for 3minutes showed both antifungal and antibacterial effect.

الخلاصة

الهدف:تهدف هذه الدراسة تقييم الطاقة الافضل للموجات الدقيقة والوقت المناسب لتطهير مادة قاعدة الطقم الاكريلية.**المواد والاساليب:**تم تحضير ٥٥ عينة من مادة قاعدة الطقم الاكريلية المتصلبة بطريقة الحمام المائي بالابعاد ١٠ملم x١٠ملمx٢ملم ثم غمرت في وسط زرعي سائل يحوي على مسحات من مرضى لديهم اطقم كاملة ثم قسمت العينات الى ١١مجموعة تطهير وبعد ذلك كل عينة وضعت في وسط زرعي سائل وخفف وزرع على اطباق وتم احتساب عدد الوحدات المكونة للمستعمرات في المليليتر الواحد.**النتائج**:اظهرت الدراسة وجود فرق معنوي بين المجاميع المدروسة.**الاستنتاجات:**اثبتت الدراسة ان الموجات الدقيقة عند طاقة ٥٤٠ واط و٩٠٠واط لمدة ٣ دقائق لها تأثير مضاد للبكتيريا و مضاد للفطريات.

Key Words: disinfection, microwave, denture base.

Dental plaque is bacterial aggregation that are attached to the teeth or other solid oral structures [(1)].

Formation of denture plaque by the normal oral flora is facilitated by the presence of debris due to poor hygiene, irregularities in the acrylic resin, the response of acrylic resin to a temperature of approximately 37°C, and the negative pressure in the acrylic resin-mucosa interface [(2)].

Dental prostheses used by patients are exposed to the normal oral microbial flora which include bacteria, viruses and fungi. Dental personnel adjusting or repairing these prostheses may therefore be at risk of contracting infections from prostheses that have not been properly disinfected [(3)].

Improved sterile techniques in handling patients' dental prostheses can substantially reduce cross contamination that may occur from the pumice and rag wheel. Thereby diminishing the patient's exposure to potentially pathogenic bacteria [4].

Soaking denture of patients with denture stomatitis in 0.2 % chlorhexidine overnight during five months led to no fungal growth either on palatal or on maxillary denture agar models, and clinical signs and symptoms were reduced [5].

Chassot *et al.,*[6] concluded that immersion for at least 5 minutes in a 0.2% peracetic acid-based disinfectant promoted high level disinfection of heat polymerized, chemically activated and microwave-polymerized acrylic resins contaminated with either human saliva or *Bacillus subtilis* or *Bacillus stearothermophilus*.

Webb *et al.,*[7] demonstrated that the microwave irradiation of dentures at a specified setting and exposure time is bactericidal and fungicidal.

Webb *et al.,*[8] studied in vivo the efficacy of two methods of denture sterilization: microwave irradiation (350W for 6 minutes) and sodium hypochlorite soak (0.02% and 0.0125% for eight hours) against *Candida albicans* and *Sterptcoccus gordonii*. The result indicated that the microwaving may be a more effective method of denture sterilization than denture soaking in sodium hypochlorite. However, compared with microwaving, hypochlorite reduces the levels of residual non viable microorganisms attached to the denture surface.

MATERIALS AND METHODS

Fifty five samples were prepared from heat cured acrylic resin (Major base 2/ Major Prodotti Dentari / Italy) in dimensions of 1cm width and length and 2mm thickness for microbiological test. Then, the samples were sterilized by autoclave at 15 pound/ inch^2 121 °C for 15 minutes. [8,9].

The samples were divided into 11 groups :The first group is negative control (untreated), the second group positive control immersed in0.02% sodium hypochlorite for 8 hours and nine groups of different microwave disinfection settings (different powers and times) include the following:

1. 900 W for 1 , 3 and 6 minuets which named 900W1,900W3and 900W6 respectively.
2. 540 W for 1 , 3 and 6 minuets which named 540W1,540W3 and 540W6 respectively.
3. 180 W for 1 , 3 and 6 minuets which named 180w1,180W3 and 180W6 respectively.

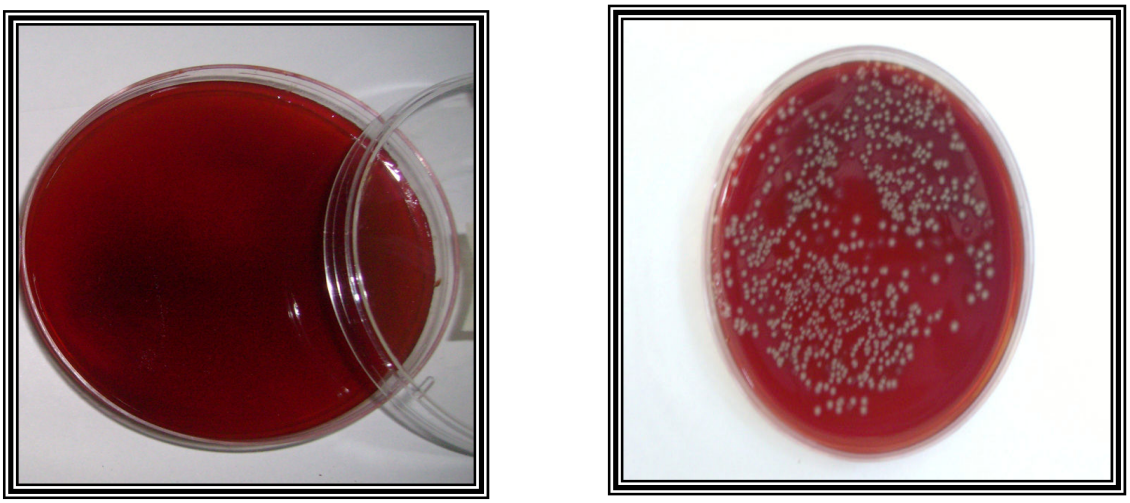
Sample Collection:

Five patients forty to sixty years old wearing complete denture for at least 1 year with normal oral mucosa and no systemic diseases were randomly selected from Department of Prosthodontics, College of Dentistry, University of Mosul. Two plaque samples were collected from each patient, with sterile cotton swabs, one sample from the denture bearing area of the palate(swab is taken from incisive papilla along middle palatine line) and one from the corresponding fitting surface of the denture. This was done immediately after the removal of the denture [10] in addition to saliva sample was collected in sterile glass flask.

Each one of the collected samples were placed in a tube of sterile brain heart infusion broth(Oxoid). Then, the inoculated brain heart broth was put together in glass flask which containing the sterile acrylic resin specimens that prepared previously, and incubated at 37°C for 48 hours.

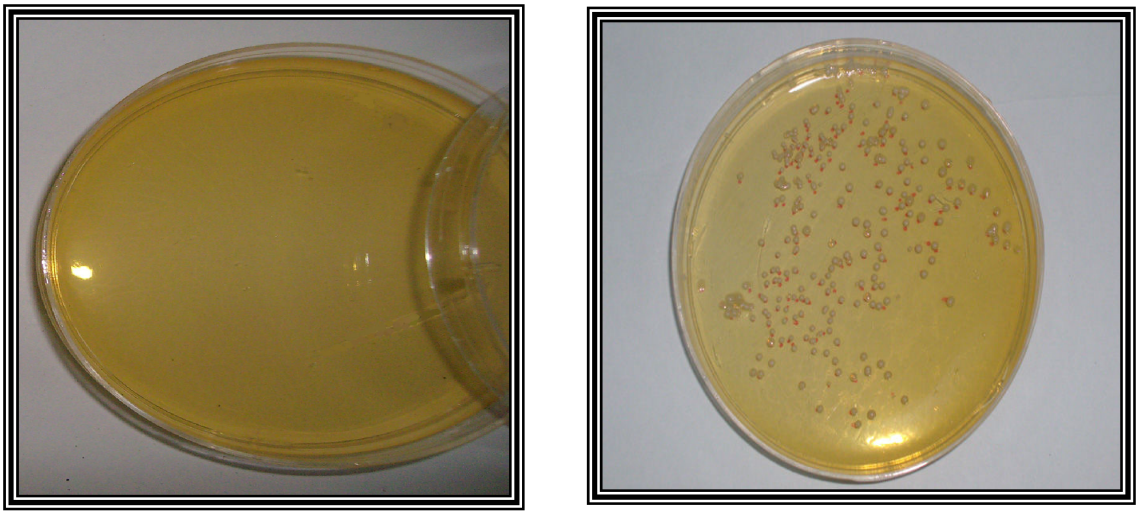
The acrylic samples was distributed as mentioned previously ,then each sample put in glass flask containing 4.5 ml of sterile brain heart infusion broth and diluted up to 10^{-4} then 0.1ml of each final dilutions were plated on three Sabouraud 's Dextrose agar plates (Himedia) and three

blood agar plates(Himedia) [10], then incubated aerobically over night(18-24 hours) and the total counts of the colony forming unit per milliliter (CFU/ml) were done [11].Figure (1,2).



A B

Figure(1): A: Blood Agar Petri dish for microwave disinfected samples; B: Blood agar Petri dish for control samples.



A B

Figure(2): A: Sabouraud's dextrose agar Petri dish for microwave disinfected samples; B: Sabouraud's dextrose agar Petri dish for the control group.

RESULLTS

The collected data were submitted to the Kruskal-Wallis analysis of variance which showed significant difference between different groups at $P \leq 0.05$ for both antifungal and antibacterial

effect as in Tables (1,2).

Table (1): Kruskal-wallis test for antibacterial effect of sodium hypochlorite and different microwave settings for Heat Cured Acrylic Resin Samples.

Source of difference	Degree of freedom	Chi-square	*P*- value
Different disinfection procedures	10	97.146	0.000

Table (2): Kruskal-wallis test for antifungal effect of sodium hypochlorite and different microwave settings of heat cured acrylic resin samples.

Source of difference	Degree of freedom	Chi-square	*P*- value
Different disinfection procedure	10	45.169	0.000

Dunn's multiple comparison test revealed the following :the antifungal effect showed a significant differences between control group and microwave disinfected groups with no significant difference between groups except 180 W for 1minutes which showed the highest mean rank of CFU/ml (98).

The antibacterial effect revealed significant differences in mean rank of CFU/ml different microwave disinfection settings and in relation to control and significant difference between different groups with lowest mean rank of CFU/ml for 900W for 3min and 6min and 540W for 3min and 6min(64) and highest value is for 900W and 540W for 1min(98.8)Table(3), and Figures (3,4).

Table (3): Dunn's multiple comparison test for antifungal and antibacterial effect by sodium hypochlorite and different microwave disinfection settings for heat cured acrylic resin.

Disinfection settings	Number of observation	Mean Rank of CFU/ml for antifungal	Multiple Comparison Grouping*	Mean Rank of CFU/ml for Antibacterial	Multiple Comparison Grouping*
900w,1min	15	73	C	84.27	BC
540W,1min	15	73	C	98.9	B
180W,1min	15	98	B	98.9	B
900W,3min	15	73	C	64	D
540W,3min	15	73	C	64	D
180W,3min	15	73	C	74	CD
900W,6min	15	73	C	64	D
540W,6min	15	73	C	64	D
180W,6min	15	73	C	78	C
NaOCL	15	73	C	64	D
Control	15	158	A	158	A

min: minutes ; W:watt

*Mean with different letters are statistically significant.

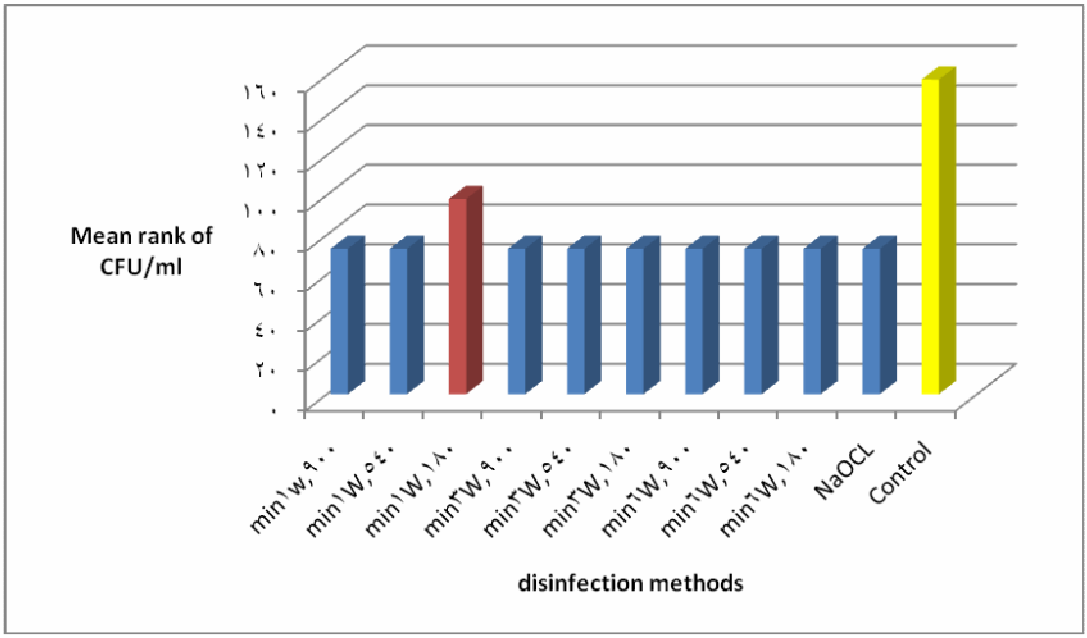


Figure (3): Mean rank of cfu/ml of antifungal effect of different microwave settings for heat cured denture base acrylic resin samples.

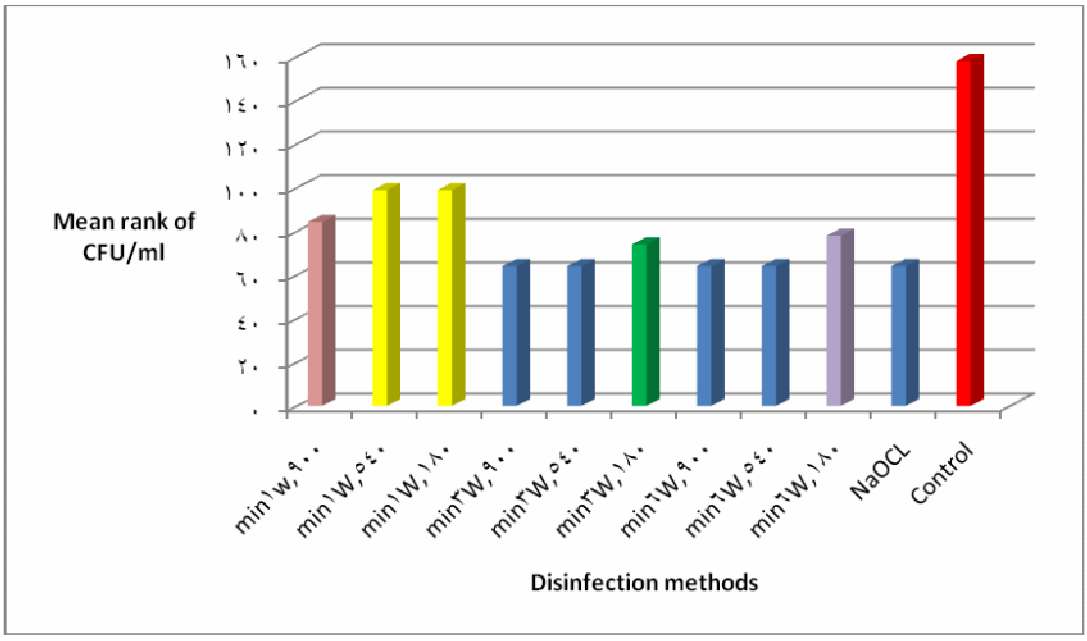


Figure (4): Mean rank of cfu/ml of antibacterial effect of different microwave settings for heat cured denture base acrylic resin samples.

DISCUSSION

The result may be attributed to the change in structural integrity and permeability of cell membrane and cell wall and may have detrimentally affected the cell metabolism that lead to cell death or cause leakage of nucleic acid and protein from cell and as the nucleic acid is responsible for the genetic propagation, the loss of this molecule may have accounted for the lack of growth of the cells [12,13].

Microwave disinfection may be owing to heating of the water in the cytoplasm of the bacteria which presumed to kill organism or render it incapable of cell division [14].

The possible explanation for such result may be due to the alteration in cell morphology[8]. This induced by progressive series of alterations which were proportional to exposure time with the final stage being complete destruction of bacterial cell[15].

Moreover, microorganisms generally contain high intracellular concentrations of ionizable compounds, which may absorb microwave thermal heat at a much greater rate than a surrounding liquid medium such as distilled water [16].

CONCLUSIONS

Microwave disinfection at 900W for 3 min ,900W for 6 min ,540 W for 3min and 540 W for 6min were the best as antibacterial and anti fungal, since there is no significance between these four settings so microwave irradiation at 540W for 3 min may be a potential treatment to prevent cross-contamination

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