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Aging Effect on Structure, Hardness, Roughness Behavior and Bacterial Adhesion on Silver- Palladium Dental Alloy

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ABSTRACT

Aging in normal saliva for different interval times make a change in internal structure (Formed phases and started base line) of Sliver- Palladium (Ag-Pd) dental alloy. Also aging in saliva for one, two and three weeks decreased Vickers hardness value, calculated maximum shear stress (τ_m) and roughness parameters for Sliver- Palladium alloy. Microbiological studies show the Candida spp. stuck on Sliver- Palladium alloy surface and their growth dependent on aging times.

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Introduction

The Ni-Cr alloys are broadly used for metal crown, bridge, and metal base of porcelain fused to metal [1]. The brilliant properties of Ni-Cr alloys are due to their complex composition. These alloys composed of (68 to 80%) Ni and (11.9 to 26.3%) Cr with other alloying elements required to the achievement of mechanical and corrosion resistance, castability and porcelain bonding [2]. Adding (0.1 to 14%) niobium, molybdenum, titanium, silicon, beryllium, manganese, cobalt, carbon, aluminum, copper, iron, gallium, magnesium and tin improved Ni-Cr alloys properties [3]. The electrochemical corrosion behavior of Ni-Cr-Mo alloy dependent on cast microstructure [4]. In artificial saliva conditioning media Cr- Co alloys have less resistance to corrosion than Ni- Cr alloys [5]. The Cr and Mo ratios in Co-Cr and Ni-Cr alloys effect on electrochemical corrosion parameters and behavior for it [6]. In Afnor artificial saliva, Studied the chief parameters of the corrosion process for five Ni-Cr or Co-Cr alloys [7]. The corrosion behavior and passive film characteristics of Co-Cr, Ni-Cr, Cu-Ni-Al alloys and commercially pure Ti in artificial saliva medium are studied [8]. Structure, hardness, roughness behavior and bacterial adhesion of Co- Cr based alloy changed after aging in saliva for different interval times [9]. Compared between the corrosion behavior of Cr-Co and Cr-Ni alloys in distilled water, orange nectar, cola and artificial saliva [10]. The corrosion process of Ni-Cr-Mo alloys in acidic artificial saliva with pH 5 at 37 °C is studied [11]. The Ag-Pd and Co-Cr have a somewhat good corrosion resistance in artificial saliva [12]. Variation in casting morphologies by casting method has only marginal influence on the overall corrosion rate and corrosion resistance property of the Co-Cr alloy [13]. The aim of this work is to study the effect of aging in saliva for different interval times on structure, hardness measurements, roughness behavior and bacterial adhesion on Ag- Pd alloy.

Materials and Methods

The commercial Sliver- Palladium (Ag- Pd) alloy is used in this studies after re-melted and casting it in convenient shape for all tests. Shimadzu X–ray Diffractometer {(Dx–30, Japan) of Cu–Kα radiation with λ=1.54056 Å at 45 kV and 35 mA and Ni–filter in the angular range 2θ ranging from 0 to 100° in continuous mode with a scan speed 5 deg/min} is used to study the change in formed phases of Sliver- Palladium alloy. A digital Vickers micro-hardness tester FM-7 from Tokyo- Japan with applying 100 gram for 5 seconds is used to measure the hardness of used samples. The mean value of all hardness measurements for each sample is calculated from ten measurements recorded for it. The surface roughness parameters and behavior for used samples are measured by Surftest S.J 201.P and Voltage Lab PGZ 100 instruments.

Results and Discussions

Effect of Aging on Structure of Ag- PD Alloy

Figure (1) shows x-ray diffraction patterns for silver- palladium dental alloy after aging in normal saliva for one, two and three weeks which show sharp lines corresponding to Ag-Pd/or Ag face centered cubic phase as recorded in x-ray cards. The shape of formed phases (Intensity of the peak which indicated to the degree of crystallinity, broadness which indicated to crystal size and position which indicated to orientation) of formed crystalline phases for Ag- Pd alloy changed after aging in normal saliva. Started base line increased (That is meant amorphous structure part increased). Also the intensity of formed phases are increased with changing the broadness of it.

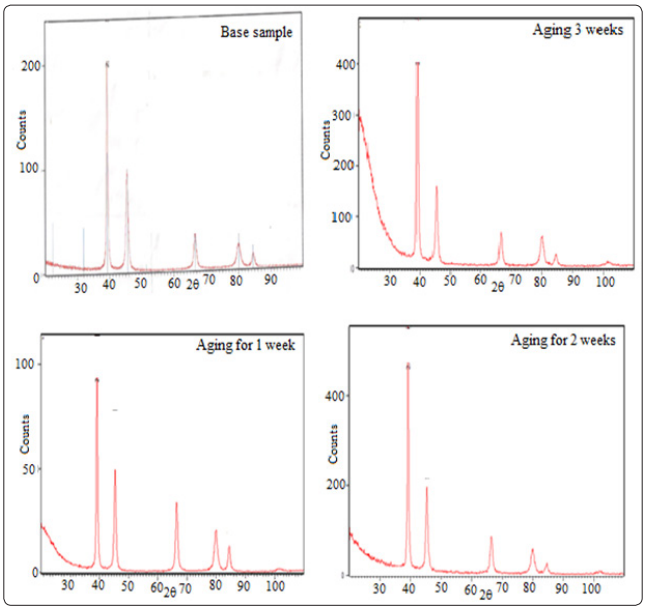

Figure 1: X-Ray Diffraction Patterns for Ag- Pd Alloy

Effect of Aging on Vickers Hardness of Ag- Pd Alloy

The surface hardness property is very important for dental materials to doing well in medical applications. Microhardness measurements for Ag-Pd alloy were done using a digital Vickers Microhardness tester by applying a load of 100 g for 5 Sec. Vickers hardness (H_V) and maximum shear stress (τ_m) for silver-palladium alloy before and after aging in normal saliva for 1, 2 and 3 weeks are listed in Table (1) which it decreased after aging in normal saliva. That is because the saliva interact with the surface with formed some layer from bacteria caused some pits or cracks on the surface.

Table 1: H_v and τ_M Values of Ag- Pd Alloy at Different Times

Samples	H_v kg/mm²	τ_m kg/mm²
Untreated	334.6	110.55
One week	306.25	101.063
Two weeks	302.23	99.92
Three weeks	299.8	98.934

Effect of Aging on Surface Behavior of Ag- Pd Alloy

The surface roughness is a significant property for alloys to doing fine in dental applications such as crown, bridge, etc…. Table (2) presented the surface parameters such as R_a, R_z, R_q, R_t, and R_p which come from the device. Lattice parameter Ra value for Ag- Pd alloy is increased after stored in saliva for different times. That is because the interaction of saliva with alloy surface caused sub- layer/or pits formed non-homogenous surface. The roughness profiles of Ag- Pd alloy before and after aging for dissimilar times are shown in Figure (2).

Table 2: HV and τ_m values of Ag- Pd alloy at different times

Roughness parameters (µm)	Interval time/ Weeks			
	Base	1	2	3
Ra	0.47	0.64	0.66	0.70
Rz	1.88	2.11	2.56	2.35
Rq	0.58	0.72	0.80	0.91
Rt	3.11	3.01	3.86	4.99
Rp	0.94	1.15	1.30	1.20

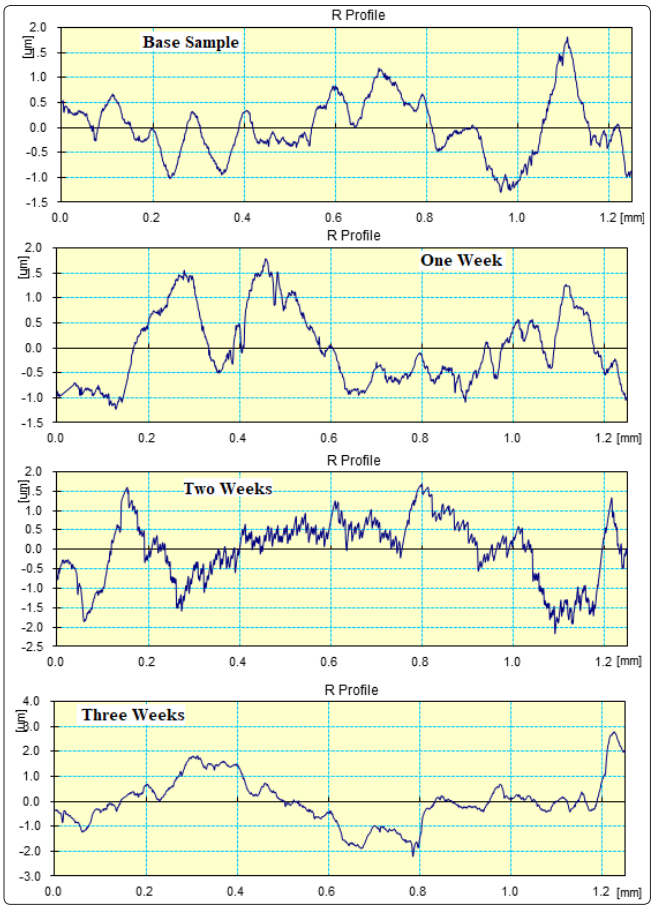

Figure 2: roughness profiles of Ag- Pd alloy before and after aging

Effect of aging on Bactria adhesion in Ag- Pd alloy surface

Microbiological studies revealed the Candida spp. is stuck on the silver-palladium alloy surface after stored in saliva for one, two and three weeks. Scanning electron micrographs, SEM, show the growth of Candida spp. on the silver-palladium alloy surface after aging in normal saliva.

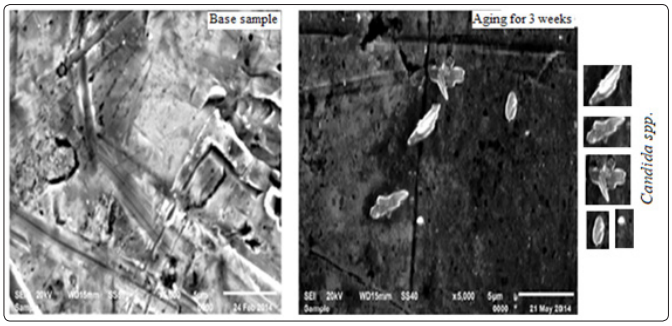

Figure 3: Seem Graphs for Candida Spp. Growth on silver-palladium alloy surface

Conclusion

Matrix structure, Vickers hardness and roughness parameters of Ag- Pd alloy changed after stored in natural saliva for different interval times.

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