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A comparative evaluation of soft denture liners

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Abstract:
Statement of problems: *Two potential problems commonly identified with a denture base incorporating a resilient liner are a failure of the bond between the acrylic resin and resilient liner material and colonization of Candida albicans over time.*
Aims: This in vitro experimental study evaluated the shear and compressive bond strength as well as colonization of Candida albicans of commonly available denture soft liners.
Materials and methods: *The denture liners investigated were acrylic resin-based heat-polymerized (Super soft) and auto-polymerized (Refit and Softliner) resilient liner. The resilient liners were processed according to manufacturers' instructions. The soft liners specimens for testing colonization of Candida albicans (n=10) were 6×3 mm. The soft liner specimen for shear and compressive strength testing (n=5) were of 6 mm diameter and 3 mm thickness. Specimens shape and linear thickness were standardized. Specimens were stored for 48 hrs, 1 week and 2 week interval for incubation at 37°C. The growth around and below the surface of the specimens were read as positive. Shear and compressive strength were measured in a universal testing machine at a crosshead speed of 20 mm/min and 2mm/min respectively. Student "t" test and ANOVA were used to analyze the data.*
Result: *Results showed that with the increase in time for incubation of test materials with Candida albicans, the adherence property of the material was increased in heat-cured and auto-polymerized soft liners. There was significant difference in compressive and shear bond strength among different soft liners.*
Conclusion- Within the limitation of this in vitro study, specimens of soft liners shows equal number of growth of Candida albicans and significant difference in shear and compressive bond strength.
Keywords: *Soft liner, Compressive strength, Shear strength, Colonization, Debonding.*

I. Introduction

The most expedient and yet the most effective method for treating abused basal tissues is for the patient to remove the dentures from the mouth for an extended period of time. For most patients, however, Social and economic considerations preclude this simple but direct approach.[1] For such condition, denture soft liners are used to refit the surfaces of complete dentures and to help condition traumatized tissue, providing and interim or permanent cushion like effect.[2, 3, 4] However, none of the material is available to fulfill all the requirements as failure have been for many reasons, like debonding from denture base,[5] distortion due to sorption of liquid and solubility in the oral environment,[6] becoming harder and change in color, stain easily, change in dimension[7-12]and due to colonization of Candida albicans and other micro-organism present in oral environment.

Moreover, these materials are considered as temporary expedients and not the permanent clinical agents. The properties of these materials are still not standardized as these materials do not have specifications of their own on which requirements the materials can be certified.[13]

Hence, the present study has been taken up to evaluate some of the essential properties such as shearing strength, compressive strength and colonization of Candida albicans on soft liners most commonly available and used in India.

II. Materials And Methods

This experimental study was carried out in the department of Prosthodontics, King George's Medical University, Lucknow and Research Design and Standard Organization, Lucknow to evaluate the different properties of soft denture liners commonly available and used.

Materials:

1- Soft denture liners: Three brands of soft denture liners were included in this study. (Table 1)
2- Nutritional broath
3- Nutritional Agar

Equipments/ Instruments and method of fabrication of specimens:

(1) Dies: Dies 1 and 2 and their accessories were prepared to obtain the required dimension of soft liner specimen for testing procedures.

Die No. 1: This die was made for testing growth of Candida albicans. The die was made of copper sheets. The length of the die was 6 cm, breadth 3 cm, and height 3 cm. The die was designed with a central hole which has a diameter of 6 mm and depth 3 mm to facilitate the uniform thickness of the specimen. (Figure 1)

The die with a central hole of 6 mm diameter and 3 mm depth and a hole plunger was made. Hole plunger was used to push the specimen out of the hole after the soft lining material was packed and the material was set in the die. (Figure 1) Plunger facilitates the easy removal of specimens from the hole without sticking or distortion.

Copper slab of 6 cm in length, 3 cm in breadth and 1 cm in thickness was made to press the lining material after packing and kept in place till the soft lining material sets, it also helps to facilitate the smooth and uniform surface of the specimens. (Figure 1 & 2)

Soft lining material at dough stage was packed into the die and copper slab of 1 cm thickness was placed on the material and pressed till the material sets. Copper slab was removed after the material was set. The plunger was pushed to facilitate the removal of soft liner specimen. The resultant specimen was of a dimension of 6 mm diameter and 3 mm thickness. Vernier caliper (Yamayo Classic, Japan, minimum measuring capacity 0.01mm) was used to measure the thickness of prepared specimens. The excess material was trimmed with a Bard Parker knife. The prepared specimens were placed in a sterile petridish in distilled water for 72 hours prior to testing. The specimens (for testing Candida albicans growth) were so prepared to facilitate their placement in test tubes for incubation. (Figure 3)

Die no. 2: This die was made for preparing specimens to test compressive and shear strength of soft liners. The stainless steel die was made with a central hole 6 mm diameter and 3 mm thickness. The die was designed so that a uniform thickness of specimen was obtained. (Figure 4)

Die was placed on the glass slab and the heat cured material was packed into the die. (Figure 4) Pressure was applied with another glass slab and allows setting to get a uniform thickness 3 mm of heat cured specimen. The excess resin was trimmed. The resultant specimens were in a measurement of 6 mm diameter and 3 mm thickness. The thickness of the specimens was measured by Vernier calipers.

Die was placed on the glass slab with the prepared heat cured specimen in place and another die of similar dimension was kept above the die along with heat cured specimen. Soft lining material at dough stage was packed into the die. (Figure 4) After packing the soft lining material into the die, pressure was applied with another glass slab and allows setting to get a uniform thickness of soft liner specimen. The resultant specimens were in a dimension of 6 mm diameter and 3 mm thickness. The prepared specimens (to test compressive and shear bond strength) were placed in sterile Petri dishes in distilled water for 72 hours prior to testing. (Figure 5)

Guide: A guide was used to hold the die in place so that movement was only in one plane, while testing for shear bond strength in an instron universal testing machine.

(a) Lock no. 1 with small holes facilitated the entry of 21 gauge stainless steel wire. The wire fixed in the hole will help to stabilize the metal guide in place. Width of the lock was 15 mm and thickness was 5 mm.
(b) Lock no. 2 also has two small holes that facilitated the entry of 21 gauge stainless steel wire. This lock was made to engage in the lock no. 1 when in use.
(c) Both locks no. 1 and 2 accurately fitted or engaged each other when the specimens in the die were kept ready to test in an instron testing machine.
(d) The specimen inside the guide stabilized by a stainless steel wire both from above and below and hooked in the instron universal testing machine and test was done.

(2) Instron testing machine (model no. 6027, Instron Ltd. Bucks H.P. 123 sy. England)
(3) Sterile petridishes
(4) Vernier calipers

Testing procedure for the observation of growth of Candida albicans:

Single colony of Candida albicans was suspended in nutrient broth and a homogenous suspension was made. One loopful of the above suspension was inoculated in each nutrient broth tubes and incubated at 37^{o}C for overnight. The purity of growth and confirmation of the organism was done by Gram's stain and turbidity of the tube was matched with 0.5 McFarland's standard tube. Into the three tubes containing 5 ml of nutrient broth with Candida albicans and specimens of soft liners were suspended.

Specimens were checked for their adherence with Candida albicans at 48 hrs, 1 wk and 2 wk interval of incubation. Specimens were washed with sterile saline, three times by agitation after the incubation of above said period and were placed on nutrient agar plates and incubated at 37^{o}C.

The growth around and below the surface of the specimens were read as positive.

Testing procedure for compressive and shear strength:

1. Shear bond strength of auto-polymerized and heat-cured soft liner was tested with the help of instron universal testing machine. The specimens were mounted vertically on the testing machine and the lid was applied at crosshead speed of 25 mm/min. The peak load was recorded for maximum shear strength at which the debonding of the soft liner from denture base material occurred. The guide was used to hold the dies in position.

2. Compressive strength of auto-polymerized and heat cured soft liner- The specimens were placed in the horizontal plate of the instron universal testing machine and load was applied vertically at a crosshead speed of 2 mm/min. The peak load was recorded for maximum compressive strength.

Five reading were taken for statistical analysis.

The values have been shown as mean ±SD/SE and intergroup comparison have been made using student "t" test. The confidence level of the study was kept at 95% and a "P" value less than 0.05 indicated statistical significance difference.

III. Result

The present study was conducted to evaluate:

i. The growth of Candida albicans on soft liners, as part 1 observation 1.
ii. Compressive and shear bond strength of soft liner bonded to denture base resins (methyl methacrylate) as part 2, observation 2.

A total number of 60 specimens were observed. In part 1 and part 2 of this study 10 specimens from each of the soft liners were prepared (i.e. each part consisted of 30 specimens)

Periodic examination for evidence of growth around and below the surface of these specimens revealed the growth starting to show on the third day of incubation with the increase in time for incubation of specimen with Candida albicans. The adherence property of the material was increased. Typical whitish Candida albicans colonies were observed attached to the below and around the surface area observed.

Table 2 showed Candida albicans growth- least in 48 hr followed by one week interval and in 2 week interval. Results showed that with the increase in time for incubation of test materials with Candida albicans, the adherence property of the material was increased in heat cured and self cure soft liners.

For observation no. 2, out of the 30 specimens, 15 specimens were tested for compressive strength, five for each 3 types of soft liners and 15 specimens were tested for shear bond strength, five for each 3 types of soft liners. After testing in an instron universal testing machine, the values were recorded and statistical analysis was done. Table 3 showed mean compressive strength of Supersoft, Refit and Softliner was 11.8146± 1.8030, 0.9527±0.1386 and 0.9964± 0.9527 MPa respectively.

Table 4 showed the variation in compressive strength in different soft liners. Since "F" is significant, hence there is significant difference in compressive strength of groups. It was found maximum for Supersoft and minimum for Refit. There was significant difference in the compressive strength of Supersoft and Refit ($P<0.001$), Supersoft and Softliner ($P<0.001$) except for Refit and Softliner ($P>0.001$).

Table 5 showed mean shear bond strength of Supersoft, Refit and Softliner is 25.9439±7.1680, 4.8528±1.7075 and 2.8962±0.3506 MPa respectively. Table 6 showed the variation in shear bond strength of different soft liner. Since "F" was significant, hence there is significant difference in shear bond strength of soft liners. It was found maximum for Supersoft and minimum for Softliner.

IV. Discussion

The increasing use of resilient of soft denture liners come into favor for various applications in prosthesis, like in the treatment of complete and partially edentulous patients especially those who are medically compromised, and when the denture bearing area shows evidence of senile and presenile atrophy.[14,15]

The soft denture liners available today do not satisfy all the requirement as they promote fungal and bacterial growth on their surface compared to the underlying supporting mucosa.[16,17] Their properties to regain and maintain their shape and size after being subjected to functional masticatory forces is of great concern for their clinical acceptance.

The present study was undertaken to evaluate the comparative clinical properties of three commercially available and commonly used brands of soft denture liners. The materials selected were processed carefully so as to avoid any processing defects e.g. porosity etc.

The observations made were divided into-

a. antimicrobial
b. physical

Antimicrobial- In antimicrobial testing, Candida albicans colonies were observed after 48 hours which went on increasing from + to +++ at the end of the second week in both the heat-cured and auto-polymerized soft liners used. Similar observations were also reported by various researchers.[18-21] This supports the observations of earlier works of different authors who did similar studies by taking swabs or imprint culture of oral mucosa and dentures. Growth of Candida albicans was more or less equal with an increasing time for incubation in both types of soft liners, which supports the previous studies of investigators.

Physical- The compressive and shear bond strength was highest in Supersoft (heat cured soft liner). The above findings indicate that the auto-polymerized soft liners are better adapted for use having better resiliency compared to the heat-cured material. The heat- cured material are able to resist more shearing forces than the auto-polymerized but the heat cure soft liner require more laboratory work compared to auto-polymerized soft liner. The heat cured material is comparatively harder.

Hence, for the treatment of various complete denture problems, the auto-polymerized soft liners was found to be acceptable as it required less laboratory work and had acceptable compressive and shear bond strength.

V. Figures And Tables

Figures:

Figure 1- Die no. 1

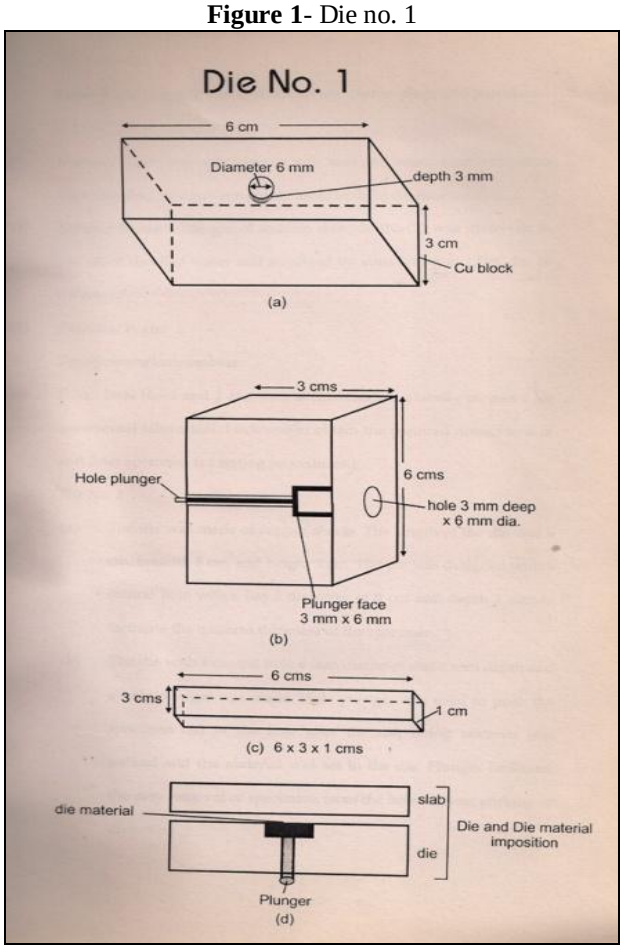


Figure 2- Copper die to prepare specimen for growth of Candida albicans

Figure 3- Specimens of Refit, Softliner and Supersoft (from left to right) for Candida albicans growth

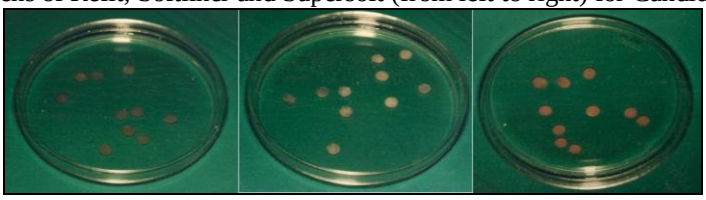


Figure 4- Die no. 2

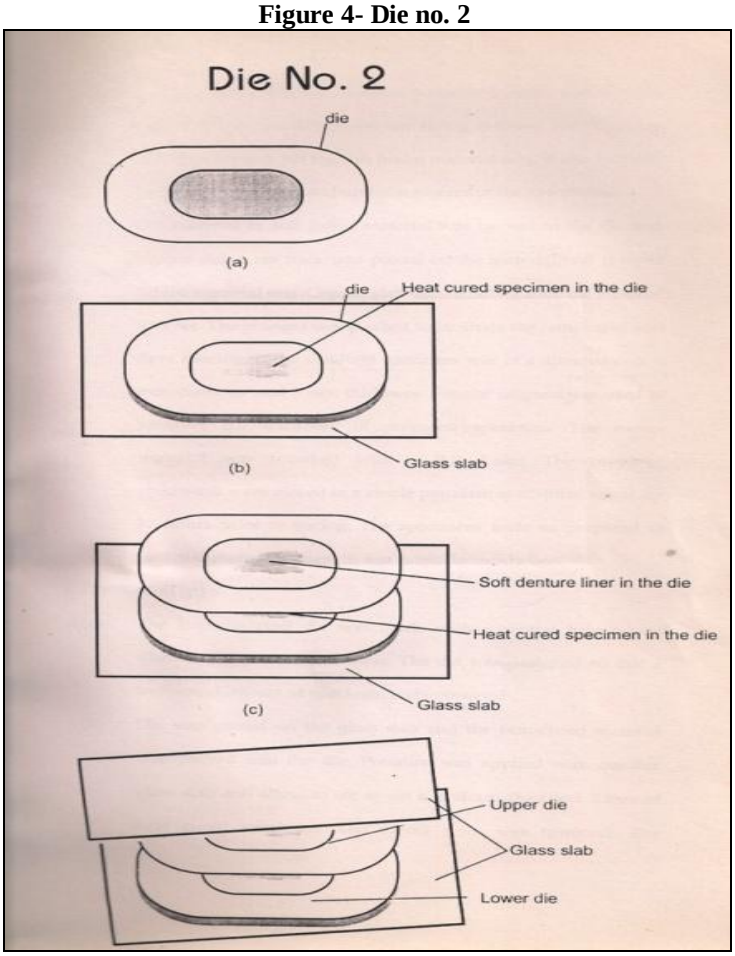
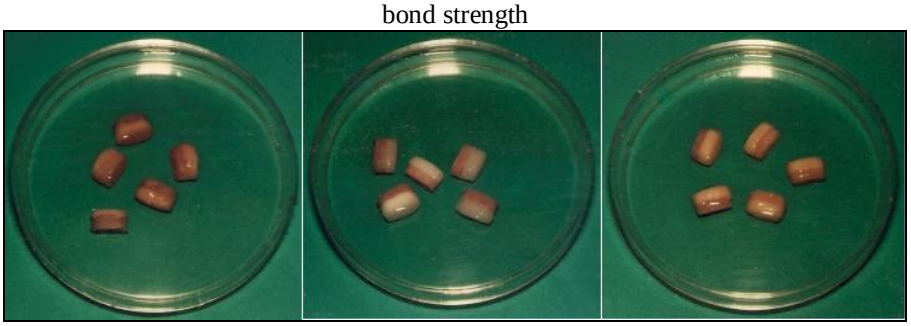


Figure 5- Specimens of Refit, Softliner and Supersoft (from left to right) for compressive and shear bond strength



Tables:

Table 1 showing brand name and manufacturers of soft liners

S. No.	Brand name	Activation	Type	Manufacturer´s name and address
1	Super soft	Heat	Acrylic	G. C. Lab. Technologies Inc. Lock-Port, USA
2	Refit	Auto	Acrylic	PSP Dental Co. Belvedere Kent, U.K.
3	Softliner	Auto	Acrylic	G. C. Corporation Tokyo, Japan

Table 2 showing growth of Candida albicans in different time interval

S.No.	Material	Growth in 48hrs	Growth in 1 week	Growth in 2 weeks
1	Super soft	+	++	+++
2	Refit	+	++	+++
3	Softliner	+	++	+++

Table 3 showing mean compressive strength of Supersoft, Refit and Softliner

	Supersoft	Refit	Softliner
N	5	5	5
Mean (in MPa)	11.8146	0.9527	0.9964
S.D.	1.8030	0.1386	0.9527

Table 4 showing comparison of compressive strength in different soft liners

ANOVA result for observation of variance of compressive strength in different soft liners				
Source of variation	Degree of freedom	Sum of square	Mean sum of square	Variance ratio
Between the groups	2	391.695	195.847	F= 179.609 (P<0.001)
Within the groups	12	13.085	1.090	
Total	14	404.780		
Showing comparison of compressive strength of different soft liners				
Bands of soft liners		't'	'P'	
Supersoft& Refit		13.4313	P<0.001	
Supersoft & Soft liner		13.4142	P<0.001	
Refit & Soft liner		0.6820	Not significant	

Table 5 showing mean shear bond strength of Supersoft, Refit and Softliner

	Supersoft	Refit	Softliner
N	5	5	5
Mean (in MPa)	25.9439	4.8528	2.8962
S.D.	7.1680	1.7075	0.3506

Table 6 showing comparison of shear bond strength in different soft liners

ANOVA result for observation of variance of shear bond strength in different soft liners				
Source of variation	Degree of freedom	Sum of square	Mean sum of square	Variance ratio
Between the groups	2	1633.096	816.548	F=45.04 (P<0.001)
Within the groups	12	217.677	18.140	
Total	14	1850.772		
Showing comparison of shear bond strength of different soft liners				
Bands of soft liners		't'	'P'	
Supersoft & Refit		6.4003	P<0.001	
Supersoft & Soft liner		7.1811	P<0.001	
Refit & Soft liner		2.5100	P<0.05	

VI. Conclusion

Based on the observations made, analyzed and duly discussed, the following conclusions were drawn:

1. The observations of part 1 showed maximum number of colonies of Candida albicans in 2 week interval and minimum number of colonies of Candida albicans in 48 hours. In both heat cured and auto-polymerized soft liners, the growth of Candida albicans was equal.
2. The observations of part 2 showed-

a. The mean compressive strength was more in Softliner when auto-polymerized soft liners were compared.
b. The mean compressive strength was more in Supersoft when auto-polymerized and heat cured soft liners were compared.
c. The mean shear bond strength was more in Refit when auto-polymerized soft liners were compared.
d. The mean shear bond strength was more in Supersoft when auto-polymerized and heat cured soft liners were compared.

Finally, it can be concluded from the study that-

1. With an increasing time for incubation, the growth of Candida albicans was more or less equal in both types of soft liners, which supports the studies of other investigators.
2. Significantly higher shear bond strength and compressive strength can be achieved with Supersoft as compared to Refit and Softliner.
3. Hence, for the treatment of various complete denture problems the auto-polymerized soft liner was found to be acceptable as it required less laboratory work and had acceptable compressive and shear bond strength.

References

[1]. Arthur O Rahn, Charles M. Heartwell, Jr. Treating abused tissues. In: Text book of complete dentures Fifth edition, N. Delhi: B C Decker, 2002:422.
[2]. Randa R. Diwan. Materials prescribed in the management of edentulous patients. In Zarb- Bolender. Prosthodontic treatment for edentulous patients. New Delhi: Mosby, Printed in India by Elsevier, 2004:198-199.
[3]. Polyzois GL, Frangou MJ. Influence of curing method, sealer, and water storage on the hardness
[4]. of a soft lining material over time. J Prosthodont 2001;10:42-45. Kawano F, Dootz ER, Koran A 3rd, Craig RG. Comparison of bond strength of six soft denture liners to denture base resin. J Prosthet Dent 1992;68:368-371.
[5]. Nesrin Anil, Canan Hekimoglu, Nesin Buyukbas, Meral T. Ercan. Microleakage study of various soft liners by autoradiography: Effect of accelerated aging. J Prosthet Dent 2002;84:394-399.
[6]. Kidd EA. Microleakage: a review. J Dent 1976;4:199-206.
[7]. Powers JM, Dennison JB, Koran A. Color stability of restorative resins under accelerated aging. J Dent Res 1978;57:964-70.
[8]. Hekimoglu C, Anil N. Sorption and solubility of soft denture liner after accelerated aging. Am J Dent 1999;12:44-46.
[9]. Dootz ER, Koran A, Craig RG. Physical property comparison of 11 soft denture lining materials as a function of accelerated aging. J Prosthet Dent 1993;69:114-119.
[10]. Wagner WC, Kawano F, Dootz ER, Koran A 3rd. Dynamic viscoelastic properties of processed soft denture liners: part II-effect of accelerated aging. J Prosthet Dent 1995;74:299-304.
[11]. Kawano F, Koran A, Inoue S. Impact absorption of four processed soft denture liners as influenced by accelerated aging. Int J Prosthodont1997;10:55-60.
[12]. Anil N, Hekimoglu C, Sahin S. Color stability of heat polymerized and autopolymerized soft denture liners. J Prosthet Dent 1999;81:481-484.
[13]. John J. Manappallil. Basic Dental Materials, 2nd edition. New Delhi: Jaypee Brothers Medical publishers (P) Ltd. 2003:421-422.
[14]. Craig RG, Powers JM. Restorative dental meterials. 11th edition, Mosby, St Louis. 2002:668-671.
[15]. Nikawa H, Jin C, Hamada T, Murata H. Interactions between thermal cycled resilient denture lining materials, salivary and serum pellicle and Candida albicans in vitro. Part I. Effect on fungal growth. J Oral Rehabil 2000;27:41-51.
[16]. Nikawa H, Yamamoto T, Hayashi S, Nikawa Y, Hamada T. Growth and/or acid production of Candida albicans on soft linig materials in vitro. J Oral Rehabil 1994;21: 585-594.
[17]. Nikawa H, Hamada T, Yamaota T. Denture plaque- past and research concerns. J Dent 1998;26:299-304.
[18]. Cawson R. A. Symposium on denture sore mouth. II. The role of Candida. Dent Pract Dent Rec 1965; 16: 138–142.
[19]. Davenport JC. The oral distribution of candida in denture stomatitis. Brit dent J 1970;129:151-156.
[20]. Turrell A.S.W. Etiology of inflamed upper denture-bearing tissues. Brit dent J 1966; 118: 542–46
[21]. Radford DR, Challacombe SJ, Walter JD. Adherence of phenotypically switched Candida albicans to denture base materials. Int J Prosthodont 1998; 11:75-81.