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RESEARCH ARTICLE

WETTABILITY OF DENTURE BASE MATERIALS: A COMPARATIVE INVITRO STUDY

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ABSTRACT

Background & objectives: In edentulous patient, the replacement of teeth and lost tissues with a complete denture to obtain an acceptable functional and esthetic result remains an important challenge for the practitioner. Retention is that quality inherent in the prosthesis to resist the forces of dislodgement along the path of placement, which is in turn dependent on the "wettability" of denture base materials. There are various types of denture base materials that are used to fabricate the complete denture prostheses. Since wettability influences comfort and retention of complete dentures, a study to comparatively evaluate the wettability property of denture base materials available in our country would be helpful in assessing their role in the success of prosthesis.

Method: Mainly five autopolymerising and five heat cure denture base materials are included in this study. The samples (200 in total) were made and the half of them was sand abraded and the remaining half was untreated. The wettability of the samples was checked with Telescopic Goniometer, using artificial saliva as the wetting medium. The wettability of the solid by a liquid is determined by measuring the contact angle (θ) between the drop of the liquid and the plane surface of the solid. A low contact angle indicates good wetting and the high contact angle value indicates poor wetting. The advancing and receding contact angles were recorded and the equilibrium contact angle is measured using the equation. The difference between the advancing and the receding contact angles (Contact angle Hysteresis) were also found which is directly related to the complete denture retention.

Results: The statistical analysis was carried out using ANOVA (Analysis of variance - Fishers F test) and Mann-Whitney 'U' test (Z) using SPSS version 10. Here mean and standard deviation of contact angle hysteresis and equilibrium contact angle of each group were also taken in to consideration. The present study showed that the surface treatment increases the wettability of the denture base materials. Among the selected five heat-cure and five autopolymerized brands, the DPI heat-cure as well as DPI autopolymerized sand-abraded samples have shown the highest range (11.3 and 10.1 respectively) of contact angle hysteresis compared to their conventional groups and believed to provide more denture retention compared to other brands selected for the study.

Conclusion: The increased surface area and the high hydrophilic nature exhibited by the sand-abraded samples is believed to be the main factor which increase its contact angle hysteresis and the increased retention of the complete denture. Among the studied samples from both autopolymerized and heat-cure materials, the DPI sand-abraded samples showed the highest range of contact angle hysteresis.

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INTRODUCTION

Oral health and oral health care are important in order to maintain proper mastication, digestion, speech, appearance, and psychological well-being. In the edentulous patient, the replacement of teeth and lost tissues with a complete denture to obtain an acceptable functional and esthetic result remains an important challenge for the practitioner (Alcibiades *et al*., 2001; Brian, 1968) The recognition, understanding, and incorporation of certain mechanical, biological, and physical factors are necessary to ensure optimal complete denture treatment (Alcibiades Zissis, 2001; Kevser *et al*., 1997) For a denture to exhibit adequate adhesion to the supporting mucosa, the saliva must flow easily over the denture surfaces

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to ensure wetting. This characteristic is referred to as "wetting", and (Kilani, 1984; Kenneth, 1998). Good wetting characteristics of denture materials are thus important.

This in study was conducted to investigate and comparatively evaluate the wettability property of ten commonly used denture base materials (5 heat- cure and 5 autopolymerized resins), commercially available in India. The aims of this in vitro study were (Alcibiades, 2001; Barbenel, 1971; Brian, 1968; Brill, 1959; Chow, 1992)

- To investigate and comparatively evaluate the wettability of selected five heat-cures and five autopolymerized denture base resins.
- To investigate whether the surface treatment (sand-abrasion) does really alter the wettability of the denture base materials.
- To investigate which one of the studied materials (both heat-cure and autopolymerized resin) does exhibit the highest range of contact angle hysteresis and therefore provide better retention of the future prosthesis.
- To investigate which one of the studied material (both heat-cure and autopolymerized resin) does exhibit the least range of equilibrium contact angle and therefore provide better comfort of the future prosthesis.

MATERIALS AND METHODS

For this study, 5 heat -cure materials and 5 autopolymerizing resins were used (Cardash *et al*., 1986; Dennis *et al*., 1991).

Table I: Materials used for the study

- **Heat cure resins**

Trade Name	Manufacturer
a. Trevalon	Dentsply
b. DPI Heat Cure	Dental products of India Ltd.
c. Acralyn – H	Asian Acrylates
d. H.C Heatcure	Pyrax Polymars
e. Ashvin-High impact	Dr. Jagadish Lal Sethi

- **Autopolymerizing resins**

Trade Name	Manufacturer
a. DPI – RR coldcure	Dental Products of India Ltd
b. Acralyn-R	Asian Acrylates
c. Comet	Comdent Corporation
d. Rapid Repair	Pyrax Polymars
e. Quick Ashvin	Dr. Jagadish Lal Sethi

- Synthetic saliva
- Methanol (Acetone free)
- Household soap
- Hindustan modelling wax
- DPI cold mold seal

Instruments Used

- Stainless steel die (20x 10x 2mm)
- Blastomatic – Sandblasting unit
- Ultrasonic cleaning unit – Ney
- Goniometer, Kernco, Model no : GII
- Microadjuster with burette.

Preparation of samples

A die of dimensions 20 x 10 x 2mm was used for preparing the samples. The wax patterns (200 samples) were prepared from modelling wax. The patterns were then invested in a metal denture flask and after it is set, the flask was immersed in boiling water for the purpose of wax elimination (Gesser, 1971; Hiroki Nikawa *et al*., 1992). After the wax is removed, the mold is coated with cold mold seal and the resin is packed in dough stage. The heat-cure material samples are then processed at 74^{o} for approximately 2 hours and then increasing the temperature of waterbath to 100^{o}c and processing for 1 hour more (John F. Miner, 1973; John J. Giglio, 1962). Out of the 200 samples made, 100 were conventional, while 100 were sand -abraded. The sand-abrasion of the samples was carried out using Blastomatic -sand blasting unit (Krishnan, 1967; Lindstrom *et al*., 1979).

Goniometer

The surface wettability of the prepared samples were evaluated using Telescopic Goniometer, Kernco Model No:G II (Kerno Instrument Co, Texas ,USA) by measuring the contact angle. The instrument can be also equipped with special photo micrographic camera attachment, which makes it possible to record the observed data (Louis J. Boucher *et al*., 1968; Louka, 1977; Mc Cabe, 1988; Masami Mukai *et al*., 1955).

Wetting Medium

The required amount of synthetic saliva (i.e. the wetting medium) was prepared at the College of Pharmacy, Thiruvananthapuram. The composition of the synthetic saliva required for the present study was obtained from a similar study reported in the Journal of Prosthetic Dentistry (J Prosthet Dent 1984;52 (2) 88-91), conducted by B.H.Z kilani *et al*.

Table 2. The composition of the synthetic saliva is as follows

Ingredient	Amount
Water (H_2O)	500ml
Xylitol	20 gm
Potassium Chloride (Kcl)	1.2 gm
Sodium Chloride (Nacl)	0.843gm
Magnesium Chloride ($MgCl_2$)	0.051 gm
Tricalcium phosphate (TCP)	20 ml
Peppermint food flavouring	5 ml
Carboxyl methyl cellulose	10 gm
Sodium hydroxide	20 ml
Total make up	1000ml

Contact angle Measurements

To measure or determine the wettability of denture base materials, the prepared and properly cleaned sample was placed on the mechanical stage of the goniometer (Michel D. Murray, 1993; Murray, 1988). After a small drop of synthetic saliva was placed on the surface of the sample using microburette, the contact angle measured initially is the Advancing Contact Angle (θ_A) .Once the drop reaches its equilibrium, it starts receding ie, Receding Contact Angle (θ_R). Both the contact angles could be measured directly. The difference between the Advancing Contact Angle (θ_A), and the Receding Contact Angle (θ_R) gives the Contact Angle Hysteresis, which is believed to be related to complete denture

retention. From the same Advancing (θ_A) and Receding contact angles (θ_R) the Equilibrium contact angle was also measured using the equation mentioned below (Monsenego, 1989; Monsenego, 1989).

$$\text{Equilibrium Contact Angle} = \frac{\theta_A + \theta_P}{2}$$

$$\text{Contact Angle Hysteresis} = \theta_A - \theta_R.$$

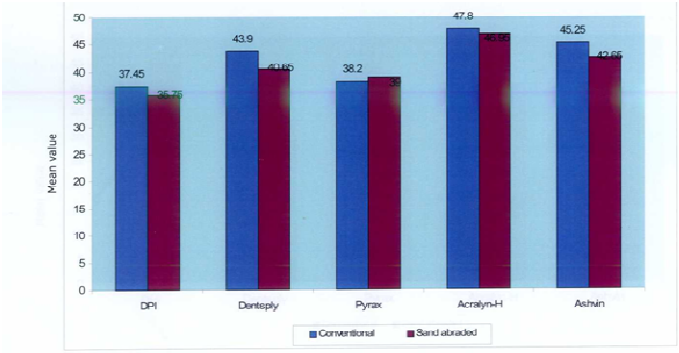
RESULTS

The statistical analysis was carried out using ANOVA (Analysis of variance - Fishers F test) and Mann- Whitney 'U' test (Z) using SPSS version 10 (Millar, 1995; Nehir Ozden Funda Akattan, 1999). The 'P' and the 'Z' values were used to compare two groups when the standard deviation was large. Here the significance was found at 5% confidence level.

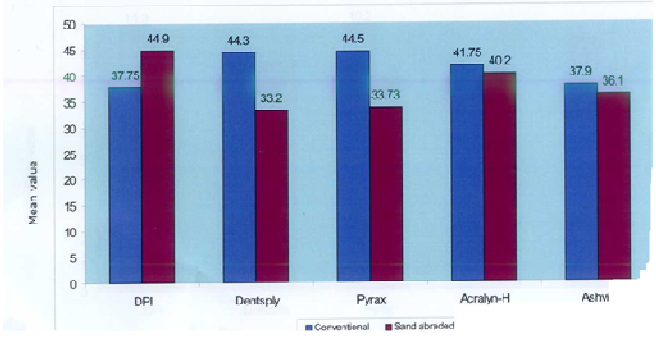
`P' Value can range to four classes.
P>0.05 – Not Significant
P<0.05- Significant
P<0.01-Highly Significant
P<0.001- Very highly significant

Retention and stability of complete denture depends upon physical, mechanical, chemical and biological factors. The objective of this in-vitro study was to investigate and comparatively evaluate the wettability of ten commonly used denture base materials (Nikolaos Vassilakos, 1993; Bearn, 1983). The results of this in vitro study proved that the sand-abrasion of samples have increased the wettability property, which is believed to be due to the surface heterogenecity of the surface and increased surface area exhibited by the sand-abraded materials.

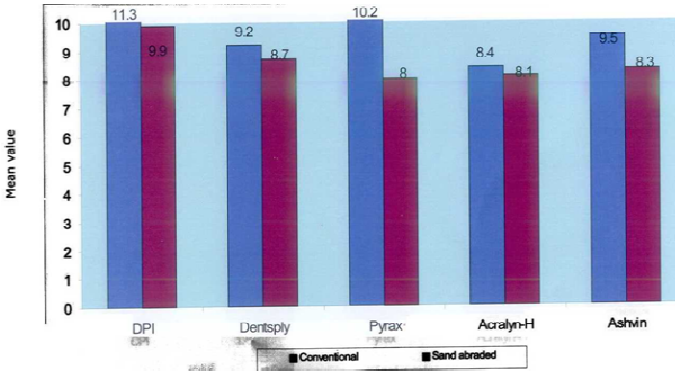
Comparison of Equilibrium Contact Angle of Heat-cure groups



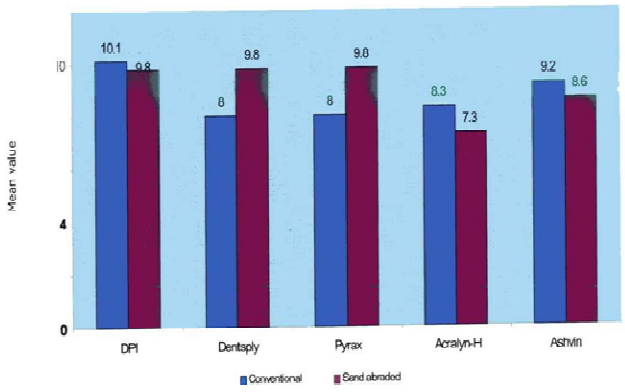
Comparison of Equilibrium Contact Angle of Autopolymerized groups



Comparison of Contact Angle Hysteresis of Heat-cure groups



Comparison of Contact Angle Hysteresis of Autopolyemerized groups



Conclusion

The heat-cure materials used for this study include DPI, Trevalon, Acralyn-H, Ashvin, and Pyrax, and the autopolymerized group of materials used for this purpose include DPI, Comet, Acralyn-R, Ashvin , and Pyrax. After the 20 samples of each material was prepared using specially prepared die, the samples were grouped into two.[35,37] The samples of group one of both heat-cure and autopolymerized materials were subjected to surface treatment, ie; sand-abrasion, whereas the samples of group two were not subjected to any surface- treatments. The prepared samples were then subjected to contact angle analysis using synthetic saliva in Telescopic Goniometer (Pekka K.Vallittu *et al*., 1994; Pekka. K. Vallittu, 1998). The equilibrium contact angle is regarded as being related to denture comfort (a high equilibrium contact angle indicates poor comfort), and contact angle hysteresis is regarded as being related to denture retention (a high contact angle hysteresis indicates good denture retention). Among the five heat- cure materials studied, the DPI heat-cure, sand-abraded material has exhibited the highest range of contact angle hysteresis and comparatively less equilibrium contact angle, and hence believed to provide better denture retention and denture comfort (Richard, 1977). Among the heat-cure conventional samples, DPI material has exhibited contact angle hysteresis and hence believed to exhibit better denture retention. Among the studied five autopolymerized, sand-abraded samples, DPI-RR cold cure has exhibited comparatively more contact angle hysteresis; and among the five autopolymerized conventionally prepared samples, again DPI-RR has exhibited highest contact angle hysteresis and hence believed to provide better denture retention. When

considering the equilibrium contact angle, among the five autopolymerized sand-abraded and conventional samples, Comet and Pyrax Rapid Repair materials exhibited least equilibrium contact angle, and therefore believed to provide better denture comfort.

REFERENCES

Alcibiades J. Zissis, Gregory L. Polyzois, Robert G.Jagger, and Mark G. J. Waters. 2001. Wettability of visible light-curing denture lining materials. *Int J Prosthodont* 14:250-254.

Alcibiades Zissis, Stavros Yannikakis, Robert G.Jagger and Mark G.J. Waters, Wettability of denture materials. Quintessence Int 2001;31:457-462.

Barbenel. J.C. 1971. Physical Retention of Complete Dentures. *J Prosthet Dent.,* 26(6):592-599.

Brian J. Battersby, Daniel H. Gehl, and William J. O'Brien Effect of an elastic lining on retention of dentures. J Prosthet Dent 1968; 20(6): 498-505.

Brill, N., Tryde, G. and Schubeler, S. 1959. The role of exteroceptors in denture retention. *J Prosthet Dent.,* 9(5): 761-768.

Chow, T.W., Ladizesky, N.H. and Clarke. D.A. 1992. Acrylic resins reinforced with woven highly drawn linear polyethelene fibres 2. Water sorption and Clinical trials. *Aust Dent J.,* 37(6): 433-438.

Criag, R.G,. Berry, G.C. and Peyton. F.A. 1960. Physical factors related to denture retention. *J Prosthet Dent.,* 10(3): 459-467.

Dennis R. Cullen, Jess W. Mikesell, and James L. Sandrik. Wettability of elastomeric impression materials and voids in gypsum casts.J Prosthet Dent 1991; 66: 261-5.

Eniko M. Veres, John F. Wolfaardt, and Petrus J. Becker. An evaluation of the surface characteristics of a facial prosthetic elastomer. Part I : Review of the literature on the surface characteristics of dental materials with maxillofacial prosthetic application. J Prosthet Dent 1990; 63: 193-7.

Gesser, H.D and C.R Castaldi. 1971. The preparation and evaluation of wetting dentures for adhesion and retention. *J Prosthet Dent.,* 25 (3): 236-243.

H.S. Cardash, R. Liberman, and M. Helft. The effect of retention grooves in acrylic resin teeth on tooth denture base- bond. J Prosthet Dent 1986; 55(4): 526-528.

Hiroki Nikawa, Hiroyuki Iwanaga, Makiko Kameda , and Taizo Hamada. In vitro evaluation of candida albicans adherence to soft denture- lining materials. J Prosthet Dent 1992; 68: 804-8.

John F. Miner. The nature of denture base: A key factor in denture sore mouth. J Prosthet Dent 1973; 29(3): 250-255.

John J. Giglio, Willian P. Lace, and Howard Arden. Factors affecting retention and stability of complete dentures. J Prosthet Dent 1962;12(5): 848-56.

Joseph E. Hamrick. 1962. A Comparison of the retention of various denture- base materials. *J Prosthet Dent.,* 12(4): 666-677.

Kenneth J. 1998. Anusavice. Phillips' science of dental materials. 10th ed. W.B. Saunders company;:25-28.

Kevser Aydin, A., Hakan Terzioglu, Kezban Ulubayram, and Nesrin Hasirci. Wetting properties of saliva substitutes on acrylic resin. Int J Prosthodont 1997; 10:473-477

Kilani, B.H.Z., D.H Retrif, M.V. Guldag, D. J Castleberry and T. E Fischer. Wettability of selected denture base materials. J Prosthet Dent 1984;52(2): 288-91.

Krishnan K. Kapur. 1967. A clinical evaluation of denture adhesives. *J Prosthet Dent.,* 18(6): 550-58.

Lindstrom, R.E., Pawelchak, J., Heyd, A. and Tarbet. W.J. 1979. Physical- chemical aspects of denture retention and stability: A review of the literature. *J Prosthet Dent.,* 42(4):371-75.

Louis J. Boucher, Charles Ellinger, Maruin Lutes and Judson C. Hickey. 1968. The effects of a microlayer of silica on the retention of material of mandibular complete dentures. *J Prosthet Dent.,* 19(6): 581-86.

Louka A. N, Gesser H.D, and Kasloff. Z. 1977. A Laboratory evaluation of the effect of two surface wetting treatment on soft- denture liners. *J Dent Res.* 56(8): 953-9.

Masami Mukai, Hisao Fukui, and Jiro Hasegawa. 1955. Relationship between sandblasting and composite resin-alloy bond strength by silica coating. *J Prosthet Dent.,* 74:151-5.

Mc Cabe J.F. 1988. A polyvinyl siloxane denture soft lining material. *J Dent.,* 26 (5-6): 521-6.

Michel D. Murray, and Brian W. Darvell. 1993. The evolution of the complete denture base. Theories of complete denture retention . A Review. Part 3. *Aust Dent J.,* 38(5):389-93.

Millar, B.J., Dunne, S.M. and Nesbit. M. 1995. A comparison of three wetting agents used to facilitate the pouring of dies. *J Prosthet Dent.,* 74: 341-4.

Monsenego and J. Proust. Complete denture retention. Part I : Physical analysis of the mechanism. Hysteresis of the solid-liquid contact angle. J Prosthet Dent 1989; 62:189-96.

Monsenego, A.Baszkin, M. de Lourdes Costa, and J. Lejoyeux, 1989. Complete denture retention: Part II : Wettability studies on various acrylic resin denture base materials. *J Prosthet Dent.*, 62:308-12.

Murray. M.D. 1988. Investigation into the effectiveness of surface treatment on poly (methyl methacrylate) when exposed in the mouth. *J Prosthet Dent.,* 59(3): 368-373.

Nehir Ozden Funda Akattan, Sefik Suzer, and Guneri Akovali. Time related wettability characteristic of acrylic resin surfaces treated by glow discharge. J Prosthet Dent 1999; 82: 680-4.

Nikawa. H, Yamamoto. T. and Hamada. T. 1995. Effect of components of resilient denture lining materials on the growth, acid production and colonization of candida albicans. *J Oral Rehabil.,* 22(11): 817-24.

Nikolaos Vassilakos, Claudio Pinheiro Fernandes, and krister Nilner. 1993. Effect of plasma treatment on the wettability of elastomeric impression materials. *J Prosthet Dent.,* 70:165-71.

Panagiotouni, E., Pissiotis, A., Kapari, D. and Kaloyannides, A. 1995. Retentive ability of various denture adhesive materials. An in vitro study. *J Prosthet Dent.,*73:578-85.

Pekka K.Vallittu, Veijo P. Lassila, and Rolf Lappalainen. Wetting the repair surface with methyl methacrylate affects the transverse strength of repaired heat-polymerized resin. J. Prosthet Dent 1994;72:639-43.

Pekka. K. Vallittu. 1998. Some aspects of the tensile strength of unidirection glass fibre-polymethyl methacrylates composite used in dentures. *J Oral Rehabit.,* 25(2):100-5.

Pratten D.H. and Craig. R.G. 1989. Wettability of hydrophilic addition silicone impression material. *J Prosthet Dent.,* 61:197-202.

Pratten, D.H., Covey, D.H and Sheats. R.D 1990. Effect of disinfectant solutions on the wettability of elastomeric impression materials. *J Prosthet Dent.,* 63:223-7.

R. K.K OW, and E. M Bearn. 1983. A method of studying the effect of adhesives on denture retention. *J Prosthet Dent.,* 50(3): 332-37.

Richard M. Hesby, Chris R. Haganman, and Clark M. Stanford. 1977. Effects of radio frequency glow discharge on impression material surface wettability. *J Prosthet Dent.,* 77:414:22.

The Glossary of Prosthodontic terms. J Prosthet Dent 1999;81(1):48-106.

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