

Comparative evaluation of Retention of Maxillary denture base without and after sandblasting of intaglio surface with Alumina particles – An in vivo study

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Abstract

Retention of maxillary complete denture is often less in fair or poor residual alveolar ridges as compared to good ridges. The aim of the study was to compare the retention of maxillary denture base before and after sandblasting the tissue surface in fair and poor residual ridge cases. For this in vivo study, 15 completely edentulous patients with fair or poor residual alveolar ridge were selected. After fabricating master cast, heat-cured denture bases were made and a hook was attached in the centre of the palate with chemically cured resin. Retention of the denture base before and after sandblasting was tested with a specially designed instrument and measured with force gauge in Newton. Results were analysed using paired t-test and statistically significant difference ($p < 0.0001$) was found between test groups. The study concluded that

sandblasting the tissue surface of maxillary denture base improves its retention in fair and poor residual ridge cases.

Keywords: Maxillary, Poor ridge, Retention, Sandblasting

Introduction

Retention, stability and support are indispensable for the success of a removable denture.^[1] Of these, Retention is of prime importance and is related to displacement of denture from its basal seat area.^[2] According to Glossary of Prosthodontic Terms, Ninth edition, Retention is defined as that quality inherent in the dental prosthesis acting to resist the forces of dislodgement along the path of placement.^[3] Physical, mechanical, psychologic, physiologic, and surgical factors affect retention.^[4] It has been well-established that physical factors like adhesion, cohesion, surface tension, capillarity, viscosity, and

atmospheric pressure affect retention of complete dentures.^[5,6]

Adequate layer of saliva is important to retention due to its physical effect. Thus, denture retention is result of interaction among several factors like surface tension and viscosity of saliva, salivary film thickness, the contact surface, and contact angle of saliva and denture.^[7] A thin film of saliva present between mucosa and the denture is the principal factor for retention due to its adhesive action. Complete wetting of the denture base with saliva is important to produce this adhesive effect.^[8] An in vitro study by Winkler et al concluded that sandblasting of methyl methacrylate decreased the contact angle and increased its wettability.^[9] An in vivo study by Hemmati et al concluded that sandblasting tissue surface of maxillary denture with alumina particles improved its retention.^[10] Husham et al evaluated 20 patients complaining of poor retention of maxillary denture. They showed significant improvement in the mean retention of well-fit dentures after air abrasion.^[11]

Because no study was specifically oriented towards fair or poor maxillary ridges, this study was conducted to assess if sandblasting the tissue surface can improve retention of maxillary dentures with fair and poor ridges.

Materials and Method

This study was conducted on 15 completely edentulous patients, both male and female, between age 40 to 72 years. Informed consent explaining the aim and method of the study was obtained from the patients. Inclusion criteria were good general & oral health; and well-healed fair to poor ridges with no undercuts. Medically compromised patients, good residual ridges and residual ridges with undercuts were excluded from the study.

Maxillary master impression was obtained after border molding with green stick compound (DPI Pinnacle, Mumbai). Modelling wax (Y-DENTS Modelling wax no.

2, MDM corporation, Delhi) was adapted (Fig 1) and flaked with Heat-cured acrylic denture base resin (ACRYLIN- 'H', Asian Acrylates, Mumbai). Thus fabricated denture base simulates maxillary denture without teeth. Then, a stainless steel hook was attached to centre of maxillary denture base on polished surface with chemically cured resin which facilitates to secure a nylon thread (Fig 2). Denture bases were stored in water until used.



Fig 1: A layer of wax adapted on Master cast



Fig 2: A hook attached in the center of maxillary denture base

The specially designed retention testing instrument was based on the device used by Stromberg and Hickey.^[12] The vertical force required to dislodge maxillary denture base was measured. Retention testing instrument had a base, a vertical stand, horizontal arm with chin rest and a dislodging rod with pulley. The horizontal arm was above

and perpendicular to the vertical stand and consisted of adjustable chin rest. The dislodging rod was attached above the horizontal arm, parallel to it and consisted of three pulleys. The narrow diameter of dislodging rod with pulley facilitated insertion into oral cavity. A nylon thread was secured to the pulleys and the other end of which was attached to Digital Force gauge (Lutron FG 5000 A) which measured dislodging force in Newton.

Patient was seated in a comfortable position in front of the instrument with chin firmly resting on the chin rest. The maxillary denture base with thread attached to the hook inserted in the mouth. Before insertion, the denture base was washed rigorously with water to reduce effect of salivary content change on retention. Patient's head was adjusted such that maxillary occlusal plane is parallel to the horizontal plane. The narrow end of dislodging rod with pulley was inserted intraorally (Fig 3a and 3b). Mouth opening was limited till insertion of dislodging rod and standardized by maintaining the distance between points marked on the tip of nose and the chin during testing. The thread was passed over pulleys and attached to the Force gauge which measured dislodging force in Newton (N). Such position ensured that dislodging forces were perpendicular to the denture base. One-minute time was allowed for complete adaptation of denture base to palate. Three consecutive readings were taken and mean dislodging force was recorded for denture base before sandblasting.



Fig 3a and 3b: Retention testing in patient

The borders and posterior palatal seal area of the same denture base were covered with aluminum foil to preserve border seal. The intaglio surface was then sandblasted with 110 μm alumina particles with 4 bar pressure at 10 mm distance and 45-degree angle for 40 seconds in sandblaster machine (Fig 4). Retention was again tested in the same manner described previously with sandblasted denture base and readings were noted.

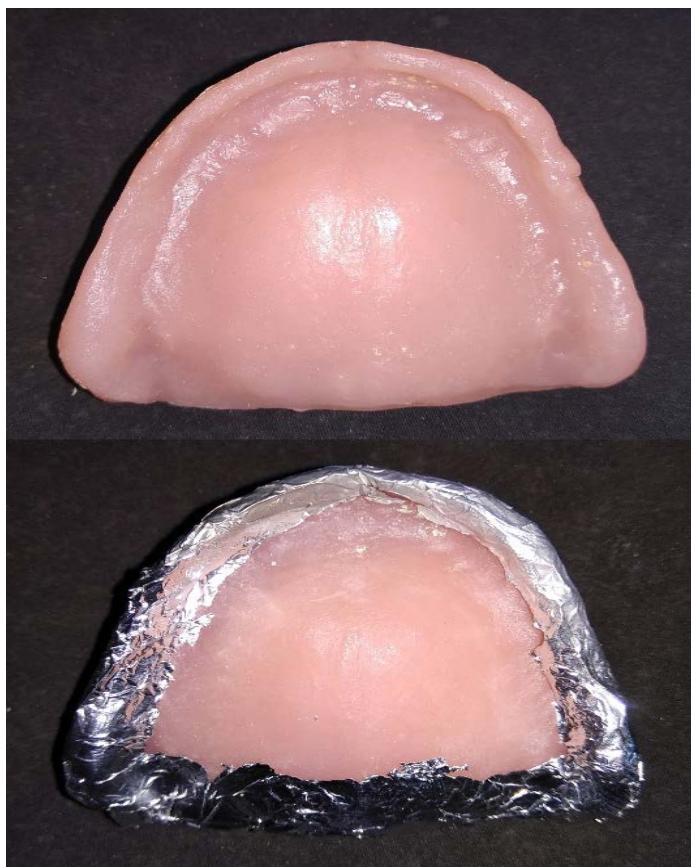


Fig 4: Before and After sandblasting

Results

Mean dislodging force before and after sandblasting for all 15 patients were recorded (Table 1) and statistically analysed with Paired t-test (Table 2).

Table 1: Mean retention force (in Newton)

Patient no.	Before Sandblasting	After Sandblasting
1	8.20	11.25
2	7.56	9.38
3	8.86	12.47
4	6.39	9.13
5	5.89	7.12
6	6.94	9.15
7	6.14	9.40
8	4.58	6.23
9	5.09	7.91
10	6.70	8.35
11	5.72	7.26
12	4.45	6.89

13	6.18	8.05
14	5.73	7.04
15	6.30	8.28

Table 2: Statistical analysis using Paired t-test

Mean dislodgement force Sandblasting (in Newton) Before (in Newton)	Mean dislodgement force After Sandblasting (in Newton)	Difference Value	Percentage difference	P value
6.32 ± 1.18	8.53 ± 1.63	2.21	+ 35.03 %	< 0.0001

Discussion

Denture retention is one of several factors which determines success of removable complete dentures. To improve denture retention, various attempts have been made in the past. In the present study, we have tried to increase surface area by sandblasting tissue surface.

Acrylic resin is resistant to wetting because of its low surface energy. Retention increases as there is increase in surface tension of fluid, wettability, and surface contact area. Retention is inversely proportional to the space between two contacting surfaces.^[9] Variety of surface treatments have been experimented to increase retention of denture, the surface energy and hence wettability and hydrophilicity.^[1,7,8,9,10,13,14] Boucher et al studied that deposition of microlayer of silica increases mandibular denture retention.^[13] O' Brien and Ryge concluded that there was increased wetting of polymethylmethacrylate by 50 to 70% after Molecular Bonding Treatment.^[8] Gupta R et al concluded that there was increased maxillary denture retention after sandblasting with 50 and 100 µm alumina particles which was statistically significant. However, no significant difference was found between 50 µm and 100 µm groups.^[1]

Previous studies are not specifically directed to test retention in fair or poor maxillary ridges. In the present study, 15 completely edentulous patients with fair to poor maxillary ridges were tested for retention before and after

sandblasting tissue surface of denture base. The mean retention force before sandblasting was 6.32 ± 1.18 N which increased to 8.53 ± 1.63 N after sandblasting. There was 35.03% increase in mean retention force after sandblasting which was statistically significant (p < 0.0001).

These findings were in agreement with the studies conducted by O' Brien and Ryge,^[8] Boucher et al,^[13] Ortman et al,^[15] Gesser and Castaldi,^[16] Winkler et al,^[9] Kikuchi et al,^[7] Saumya Sharma,^[14] Hemmati et al,^[10] Gupta R et al.^[1] However, the findings of the present study seem to be in contrast to the views of M.D Murray^[17] and Darvell and Clark.^[18] According to M.D. Murray, any surface treatment would be nullified by deposition of salivary protein on treated surface.^[17] Darvell and Clark stated that surface treatments of denture bases were either of dubious validity or immediately negated by the adsorbed film from saliva.^[18]

But, in our study, retention was increased significantly after sandblasting. Because of uniformly increased surface roughness, adhesion of saliva to the tissue surface of denture base was increased along with surface roughness. There was creation of porosities which entrapped salivary molecules and improved the wettability and hydrophilicity of otherwise low surface energy PMMA resin material. The receding contact angle values might have decreased which is favourable to denture retention. As sandblasting

significantly improved retention, timely modification of intaglio surface with air-particle abrasion could be beneficial.^[7]

Maxillary denture bases were used instead of actual dentures for several reasons: to eliminate the effect of occlusal errors; to avoid leverage forces exerted upon denture bases and patient's habits on recording the retention values. The substantial variations between patients and within same patient for all of the measurements of retention might be due to several reasons: dimensions of residual ridges, surface area; seating force; the change in amount and consistency of saliva between measurements.^[13]

The disadvantage of this procedure is roughening of the tissue surface which may cause mechanical irritation.^[13]

Also, there is increased adherence of microbe like candida albicans to the roughened surface.^[19,20] However, O'Brien and Ryge observed that there was improved cleanliness and non-adherence of chewing gum to teeth of denture after wearing silica coated denture for 1 month.^[8] But emphasis should be given to denture and oral hygiene for patients wearing sandblasted dentures.

Conclusion

Within limitations of the present study, sandblasting the tissue surface of maxillary denture in patients with fair or poor ridges increases retention. However, sandblasting should not be relied upon to improve retention of inaccurate and ill-fitting dentures.^[14]

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