(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 7, Issue 3, Page No: 446-458
May-June 2024

IJMSCR

A Comparative Evaluation of Retention of Patient's Existing Maxillary Denture with Corresponding Relined Maxillary Denture Base and Newly Fabricated Maxillary Denture Prosthesis

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Introduction

In case of chronically ill and debilitating patients, to attend several chairside appointments for fabrication of complete dentures becomes a challenging task. Prosthodontic rehabilitation of these patients can be effectively done by relining their old ill-fitting dentures. This study aims to assess the retention values of maxillary dentures in patients which were fabricated five to ten years back, to that of their corresponding relined dentures and newly fabricated maxillary denture prosthesis. The proposed null hypothesis of this study states that there is no difference in the retention values of the maxillary dentures to be tested.

Materials and Method

Twenty completely edentulous individuals belonging to the age group of 50-80 years were selected. Retention values of the patients' existing maxillary dentures fabricated five to ten years back, were determined. These existing maxillary dentures were relined and at the same time a set of new complete denture were fabricated. The retention values of the relined denture and the newly fabricated maxillary denture were evaluated. For mean comparison among the groups ANOVA one way test was used. For multiple mean comparisons Tukey's post hoc test was applied.

Results

The retention values of the patients' existing maxillary dentures increased significantly when the dentures were relined using hard relining material. The retention values of the relined dentures were comparable to that of the newly fabricated maxillary denture prosthesis.

Conclusion

Relining can be a cost-effective alternative for chronically ill and debilitating patients to avoid the multiple chairside appointments required for fabrication of a new set of dentures.

Keywords: edentulism, maxillary complete denture, relining, retention

Introduction

According to *Glossary of Prosthodontic Terms-9*, a conventional complete denture is a fixed or removable dental prosthesis that replaces the entire dentition and associated structures of maxillae or mandible.[1] The goal of dental prosthesis is to maintain oral health, function, aesthetics, comfort, and psychological well-being of the patient. Success of a complete denture depends on several factors. So, a proper treatment planning is essential to obtain a predictable treatment outcome.

Glossary of Prosthodontic Terms-9 has defined retention of the denture as the "resistance of the denture to dislodgement". [1] It is the resistance in the movement of a denture away from its tissue foundation especially in a vertical direction and is a quality of a denture that holds it to the tissue foundation and/or abutment teeth and stability as the resistance to horizontal and rotational forces. This property prevents lateral or anteroposterior shunting of the denture base.[2]

According to *Glossary of Prosthodontic Terms-9*, relining is defined as "the procedures used to resurface the intaglio of a removable dental prosthesis with new base material, thus producing an accurate adaptation to the denture foundation area." [1] The process of relining involves addition of a layer of processed relining material to the tissue surface of the existing denture base. This is done without changing the existing occlusal relationships and maintaining the esthetic support of the lips and face. When minimal or moderate changes are evident in the adaptation of the existing denture base, relining is the treatment of choice. A thin layer of impression material is added in the denture borders to compensate for resorptive changes that have occurred in the basal seat.

Aging is a universal process and a normal inevitable biologic phenomenon. The foundation that supports a denture, changes adversely because of varying degrees and rates of residual ridge resorption. Resorption of residual ridges is a complex biophysical process. Boucher CO [4] stated that, one problem is more serious than any other in the clinical treatment of edentulous patients–continuing resorption of residual ridges. It leads to the need for repeated replacement and refitting of dentures and periodic occlusal reshaping of teeth on dentures.

Dentures are relined or replaced with new dentures to improve occlusion, stability, retention, and facial support. These procedures are performed by clinicians with the belief that well-fitting dentures will continue to maintain the oral structures and the supporting tissues in harmony and satisfy patients by improving oral function and self-esteem. [3] Relining becomes an option when patients cannot afford the cost of having new dentures constructed, or when the construction of new dentures becomes a challenging task in case of debilitating or chronically ill patients. The aim and objective of the study was to assess the retention values of maxillary dentures in patients which were fabricated five to ten years back, to that of their corresponding relined dentures and newly fabricated complete dentures. A specially designed T-apparatus following the principle of application of force at right angle to the maxillary denture base to evaluate denture retention, as stated by Skinner and Chung was used to measure the value of denture retention.[5] As stated by Kumar and Thombare in their study, dislodging force was activated using the "spindle-handle mechanism" that was incorporated in the apparatus. [6]

Materials And Methods

Twenty completely edentulous individuals wearing maxillary and mandibular dentures which were fabricated five to ten years back, of either sex in the age group of 50-80 years, were selected for the study from the Department of Prosthodontics and Crown & Bridge. Formal ethical clearance approval was obtained from Institutional Ethics Committee (IEC), Gurunanak Institute of Dental Sciences and Research, Kolkata, West Bengal, India. Dentures with severe loss of vertical dimension were not selected for the study. Also, patients with less than average ridge height and with any kind of bony pathoses, were excluded from the study.

The subjects were further divided into two groups. The first group consisted of twenty individuals with existing denture five to seven years old (Group A), the second group consisted of twenty individuals with existing denture seven to ten years old (Group B). Written patient consent was obtained individually from all the subjects prior to the beginning of the procedure.

Study technique:

Fabrication of conventional complete dentures

Fabrication of maxillary and mandibular complete dentures were done following the conventional

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methods of denture fabrication (Figure 1a and 1b). After the final finishing and polishing of dentures, a 19-gauge stainless steel loop (KC Smith Ortho Ltd., UK) was fixed at the point of intersection of two lines joining the canine eminence and maxillary tuberosity [6], using auto-polymerized acrylic resin(DPI, India) (Figure 2). The loop was designed to engage the hook attached to the nylon fishing line (Asian Hobby Crafts LLP, India) of the apparatus used to record the retention values (Figure 3). Retention of the existing maxillary dentures denture recorded in a similar way.

For relining of the existing maxillary denture

Relining of patient's existing maxillary complete denture was done using the closed-mouth technique, described by Winkler. [7] Existing centric occlusion and intercuspation was used as a means to seat the dentures in adequate vertical dimensions .The denture was prepared before making the impression by relieving all large undercuts and by relieving 1.5 -2 mm from the tissue surface. The borders were reduced 1 - 2 mm except the posterior border (Figure 4 and Figure 5). The borders of the dentures were reformed to their functional contours by using low-fusing modeling compound (DPI Pinnacle Tracing Sticks, Mumbai). A zinc oxide-eugenol (DPI Impression Paste, Mumbai) wash impression was made by asking the patient to close his mouth lightly in maximum intercuspation. Once the relined denture was fabricated, it was finished and polished subsequently. The retention value of the denture was measured by the same method as described in the above sections.

Apparatus for measuring retention

In 1953, Skinner EW, Campbell RL, Chung P [8] used an apparatus based upon the principle of application of force at right angle to the maxillary denture base to evaluate the retention of the denture. The direction of force in caudal direction was applied by engaging the hook by nylon fishing line suspended perpendicularly. The hook was fixed at the centre of the palatal vault of the denture base. The other end of the nylon fishing line was engaged to a dynamometer that measured the retentive values by applying a dislodging force. Dislodging force was created by rotating 'Spindle-handle' in a clockwise direction. A digital hanging weight measuring scale (Weiheng, China) was used to record the values of retention. (Figure 6 and Figure 7).

The patient's head was positioned at a desired level using cephalostat. The denture base was then firmly seated over the foundation and was kept in position for 2 min. The apparatus was then adjusted vertically at required height and horizontally for locating the hook of nylon fishing line perpendicular to the loop fixed at the centre of the palatal portion of denture base. The chin support of the instrument was then adjusted to a position so that the patient's chin could completely rest on that (Figure 8a and 8b). By rotating the handle in a clock-wise direction, the required force was created and was applied slowly on the denture base till the maxillary denture base was dislodged. The values recorded in the digital weight measuring scale was the force required to dislodge the denture. The recorded values were measured in grams.

Statistical analysis of data

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and for Graphs M.S office 2013 was used. Data had been summarized as mean and standard deviation for numerical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. For mean comparison among the groups ANOVA one way test was used. For multiple mean comparisons Tukey's post hoc test was applied. If the calculated *p*-value is below the threshold chosen for statistical significance (usually the 0.05), then the null hypothesis is rejected in favour of the alternative hypothesis. p-value $\leq$ 0.05 was considered for statistically significant.

Results

The mean retention value of existing denture (A1) in Group A (existing denture five to seven years old) was found to be 874.80 ± 184.09 grams whereas, the mean retention value of its corresponding relined denture (A2) was found to be 2363 ± 608.52 grams. The difference in distribution of mean in both the above-mentioned dentures was found to be significant (p = 0.000). Similarly, distribution of mean in existing dentures and their corresponding newly fabricated denture (A3) with a mean = 2803.80 ± 764.32 grams was found to be significant (p = 0.000). The difference in distribution of mean in case of a relined denture and newly fabricated denture was found to be insignificant (p = 0.217). This signifies that retention provided by

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both the dentures are comparable. [Table 1 and Table 2].

The mean retention value of existing denture (B1) in Group B (existing denture seven to ten years old) was found to be 555.20 ± 196.06 grams whereas the mean retention value of its corresponding relined denture (B2) was found to be 1400 ± 430.13 grams. The difference in distribution of mean in both the above-mentioned dentures was found to be significant (p = 0.002). Similarly, distribution of mean in existing dentures and their corresponding newly fabricated denture (mean = 2334.50 ± 689.69 grams) was found to be significant (p = 0.000). The difference in distribution of mean in case of a relined denture and newly fabricated denture (B3) was found to be significant (p = 0.001). This signifies that retention provided by relining a seven to ten years old denture is significantly lesser in comparison to a newly fabricated maxillary denture. [Table 3 and Table 4].

Table 5 shows the mean comparison of dentures between Group A and B. The minimum retention value for Group A1 was 473 grams and for Group B1 was 240 grams. The maximum retention value for Group A1 was 1069 grams and for Group B1 was 805 grams. The mean value derived was 874.80 grams for Group A1 and for Group B1 was 555.20 grams. The standard deviation for Group A1 was 184.09 and for Group B1 was 196.06. The difference between retention values of Group A1 and Group A2 was statistically significant with a p-value of 0.001. So, it was concluded that with increase in the time period of denture wearing, there is decreased retention of the dentures due to continued residual ridge resorption.

Discussion

Conventional maxillary and mandibular complete dentures have been regarded as a standard of care for rehabilitating completely edentulous patients. Optimal outcome of a successful complete denture depends on the harmonious acceptance of the prosthesis by the oral musculature. The foundation that on which a denture seats, undergoes constant alteration as a result of differential rates of residual ridge resorption. The panacea to deal with this is to reline the existing denture if all other variables like the occlusal vertical dimension, centric and eccentric contacts of the occlusion remain acceptable or to fabricate a new set of dentures.

Van Meegen HG, Kalk W (2011) stated that when the fit of a removable complete denture is diminished as a result of progressive alveolar bone reduction, relining or rebasing might be indicated. Relining is accomplished by resurfacing the tissue side of the existing denture with a new processed material to fill the gap that exists between the original denture contour and the altered tissue contour. [9] Kranjcic J, Kostelic Stunic M, Celebic A, Komar D, Mehulic K (2012) conducted a study to assess patients' satisfaction with their old, usually poorly fitting dentures and the effect of denture relining to the patient's satisfaction. They concluded that, denture relining affects patient's satisfaction with their dentures. After relining, patient's masticatory function improved, satisfaction with chewing ability and comfort were greater, and denture hygiene better. [10]

In the present study, maxillary dentures five to ten years old were relined. Alsaggaf A, Fenlon MR (2020) stated that, patients wearing complete dentures for more than 5 years had significantly more residual alveolar ridge resorption than was found in non-denture wearing edentulous patients. [11] Christensen GJ (1995) stated that, over years of use, complete dentures become ill-fitting because of continued bone and soft tissue changes. [12] Relining or rebasing of complete dentures become necessary mainly because of tissue changes related to bone resorption. Jo W (1970**)** in his study concluded that, prolong use of dentures lead to atrophy of ridges. Maximum resorptive changes were seen in the initial five years ± 2 years of continued denture use followed by subsequent atrophy of ridges in long term denture wearers. [13] Similar results were concluded in the studies conducted by Pietrokovski J, Harfin J, Levy F (2003) and Kalk W, De Baat C (1989). [14] [15]

A denture can be relined using open-mouth or closed-mouth technique.[7] In the present study, relining of the maxillary dentures were done using the closed mouth technique as described by Winkler S (1988). [7] In a study by Utz KH, Schneider D, Feyen J, Gruner M, Bayer S, Fimmers R et al. (2012), they found out that relining complete dentures with the open-mouth technique led to a substantial denture shift resulting in inevitable clinically relevant occlusal discrepancies. [16]

Relining was done by heat-cured polymethylmethacrylate resin material. Aydın AK,

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Terzioglu H, Akınay AE, Ulubayram K, Hasirci N (1999) in their study stated that, dentures constructed of two different materials can only be successful if a satisfactory bond between these two materials exist. [17] In other words, the most common reason for failure of soft-lined dentures is the basic structural difference of the two materials. Heat-cured acrylic base material that was used as the control group in their study, had the highest tensile strength which indicated superior bond strength to that of soft-liner material. This is in accordance with the study conducted by Nassif J, Jumbelic R (1984), where they recommended the use of heat-cured resin for processing of relined dentures. [18]

In this study, the retention of the patient's existing maxillary denture, the corresponding relined maxillary denture base and the newly fabricated maxillary denture prosthesis of the patient was recorded using specially designed T-apparatus based upon the principle stated by Skinner EW, Campbell RL, Chung P. [8] In 1953, Skinner EW, Campbell RL, Chung P used a specially designed T-apparatus following the principle of application of force at right angle to the maxillary denture base to assess the denture retention. [8] This is in accordance with the studies by Colon A., Kotwal K. and Mangelsdroff D. (1982) and Yarapatineni R, Vilekar A, Kumar JP, Kumar GA, Aravind P, Kumar PA (2013). [19] [20] The direction of force in caudal direction was applied by engaging the hook by nylon fishing line suspended perpendicularly.

Table 1 and Table 2 shows the mean distribution of retention values of 10 completely edentulous patients with maxillary dentures five to seven years (5 to 7 years) old. A significant increase in the amount of retention values was seen when an existing maxillary denture (5-7 years old) is relined or when a new denture is given to the participant. This finding is in accordance with the study conducted by Gupta R, Luthra RP, Gautam D (2017).[21] In their study they evaluated the effect of relining on retention of denture bases and also compared the retentive qualities of hard chair side relining materials on maxillary denture base. They concluded that, the difference in retention values before and after relining was significant. The retention of relined dentures improved significantly when the dentures were relined by hard relining materials. Also, the retention values of the dentures before and after relining was in accordance of the retention values that were obtained in the present study. The difference in distribution of mean in case of a relined denture and newly fabricated denture was found to be statistically insignificant (p = 0.217). However, the individual retention values of the newly fabricated denture were greater than the individual values of the relined denture. But statistically the values were comparable. So, it can be concluded that, a five to ten years old relined denture can be used as an effective alternative for newly fabricated dentures.

Table 3 and Table 4 shows the mean distribution of retention values of 10 completely edentulous patients with maxillary dentures seven years to ten years (7 to 10 years) old. The mean retention value of existing denture in Group B was found to be 555.20 ± 196.06 grams whereas the mean retention value of its corresponding relined denture was found to be 1400 ± 430.13 grams. The mean difference was 845.30 grams. The difference in distribution of mean in both the above-mentioned dentures was found to be significant (p = 0.002). Similarly, distribution of mean in existing dentures and their corresponding newly fabricated denture (mean = 2334.50 ± 689.69 grams) was found to be significant (p = 0.000). This signifies that, there is a significant increase in the amount of retention values when an existing maxillary denture (7-10 years old) is relined or when a new denture is given to the patient. The difference in distribution of mean in case of a relined denture and newly fabricated denture was also found to be significant (p = 0.001). This signifies that retention provided by relining a seven to ten years old denture is significantly lesser in comparison to a newly fabricated maxillary denture. This inference can be supported by the study conducted by Pietrokovski J, Harfin J, Levy F (2003), where they concluded that, the wear and pressure, represented as time and prolonged denture use, may be factors conducive to extensive reduction of the denture supporting edentulous tissues. [14]

Table 5 shows the mean comparison of dentures between Group A and B. The minimum retention value for Group A1 was 473 grams and for Group B1 was 240 grams. The maximum retention value for Group A1 was 1069 grams and for Group B1 was 805 grams. The mean value derived was 874.80 grams for Group A1 and for Group B1 was 555.20 grams. The standard deviation for Group A1 was 184.09 and for Group B1 was 196.06. The difference between retention values of Group A1 and Group A2 was statistically significant with a p-value of 0.001. So, it

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was concluded that with increase in the time period of denture wearing, there is decreased retention of the dentures due to continued residual ridge resorption. Patients using those dentures even after 5years without getting them relined result in added instability of the dentures and increased harmful forces on the denture bearing area leading to atrophy of underlying ridges. This finding is in accordance with the studies conducted by Alsaggaf A, Fenlon MR (2020) [11], Christensen GJ (1995) [12], Jo W (1970) [13], Pietrokovski J, Harfin J, Levy F (2003) [14] and Kalk W, De Baat C (1989) [15].

The minimum retention value for Group A2 was 1502 grams and for Group B2 was 986 grams. The maximum value for Group A2 was 3567 grams and for Group B1 was 2060 grams. The mean value derived was 2363 grams for Group A2 and for Group B2 was 1400.50 grams. The standard deviation for Group A2 was 608.52 and for Group B2 was 430.13. The difference in mean between Group A2 and B2 was statistically significant with a p-value of 0.001. So, it was concluded that the retention of a relined denture significantly improved as compared to the retention values of the existing dentures.

The mean retention value of the newly fabricated maxillary denture in Group A was 2803.80 ± 764.32 grams. The mean retention value of the newly fabricated maxillary denture in Group B was 2334.50 ± 689.69 grams. The standard deviation of Group A3 was 764.32 and that of Group B3 was 689.69. The difference in mean between Group A3 and Group B3 was statistically non-significant with a p-value of 0.167. The retention value of newly fabricated maxillary denture is in accordance with the results obtained in a study conducted by Kaur S, Datta K, Gupta SK, Suman N (2016) [22]. The mean retention value of a newly fabricated maxillary denture in their study was 2765.0 grams which is comparable to the retention values obtained in the present study. They concluded that, the retention of a maxillary prosthesis is dependent upon many factors as the forces of adhesion, cohesion, interfacial surface tension, gravity, intimate tissue contact, peripheral (border seal), atmospheric pressure, and neuromuscular control, resist the displacement of a prosthesis in an occlusal direction. The most important single factor on which retention depends is the border seal.

So, it can be concluded that, a seven to ten years old denture should be replaced with a new set of dentures instead of relining. The probable reason for decreased retention value in comparison to that of the newly fabricated denture base can be extensive decrease in ridge height and changes in supporting structures due to prolong use of dentures and deformation of the denture base and loss of surface characteristics and anatomical imprints of the patients' tissue surface on the intaglio surface of the denture. Therefore, in accordance to the results and their corresponding data, this study doesn't comply with the proposed hypothesis and states that there is a significant difference in the retention of the relined maxillary dentures when compared to their newly fabricated maxillary dentures.

Limitations Of The Study

1. In the present study, measurements of the dislodging force were made from the force transducer device, by a single operator. Such subjective evaluation could vary among different observers.
2. A larger sample size would have yielded more conclusive results.

Conclusion

The following conclusion can be drawn:

1. There is a significant increase in the retention value of the patient's existing maxillary denture, five to ten years, when the denture is relined using heat cure acrylic resin material.
2. Relining patient's five to ten years old existing maxillary denture with heat cure acrylic resin proved to be sufficiently retentive with the mean retention values statistically insignificant and comparable to that of the retention values of the newly fabricated maxillary denture.
3. Relining of dentures can be an effective, cost-efficient alternative to that of fabrication of new set of dentures.

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Tables

Table 1 : Mean comparison of dentures among Sub-groups of Group A.

Subgroups	N	Min	Max	Mean	SD	F value	P value
Group A1	20	473.00	1069.00	874.80	184.09	31.011	0.000 S
Group A2	20	1502.00	3567.00	2363.00	608.52		
Group A3	20	2024.00	4383.00	2803.80	764.32		

Statistical Analysis: ANOVA one way test.

S: Statistically significant if P≤0.05;

NS: Not significant.

Table 2: Multiple comparisons of Subgroups of Group A dentures.

Subgroups	Mean	SD	Mean difference	P value
Group A1	874.80	184.09	1488.20	0.000 S
Group A2	2363.00	608.52		
Group A1	874.80	184.09	1929.00	0.000 S
Group A3	2803.80	764.32		
Group A2	2363.00	608.52	440.80	0.217 NS
Group A3	2803.80	764.32		

Statistical Analysis: Tukey's post hoc test.

S: Statistically significant if P≤0.05;

NS: Not significant.

Table 3: Mean comparison of Maxillary dentures among Sub-groups of Group B.

Subgroups	N	Min	Max	Mean	SD	F value	P value
Group B1	20	240.00	805.00	555.20	196.06	33.991	0.000 S
Group B2	20	986.00	2060.00	1400.50	430.13		
Group B3	20	1480.00	3396.00	2334.50	689.69		

Statistical Analysis: **ANOVA one way test.**

S: Statistically significant if P≤0.05;

NS: Not significant.

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Table 4: Multiple comparison of Subgroups of Group B.

Subgroups	Mean	SD	Mean difference	P value
Group B1	555.20	196.06	845.30	0.002
Group B2	1400.50	430.13		S
Group B1	555.20	196.06	1779.30	0.000
Group B3	2334.50	689.69		S
Group B2	1400.50	430.13	934.00	0.001
Group B3	2334.50	689.69		S

Statistical Analysis: **Tukey's post hoc test.**

S: Statistically significant if P≤0.05;

NS: Not significant.

Table 5: Mean comparison of retention of dentures between Group A and Group B.

Subgroups	Min	Max	Mean	SD	Mean difference	t value	P value
Group A1	473.00	1069.00	874.80	184.09	319.60	3.758	0.001
Group B1	240.00	805.00	555.20	196.06			S
Group A2	1502.00	3567.00	2363.00	608.52	962.50	4.084	0.001
Group B2	986.00	2060.00	1400.50	430.13			S
Group A3	2024.00	4383.00	2803.80	764.32	469.30	1.442	0.167
Group B3	1480.00	3396.00	2334.50	689.69			NS

Statistical Analysis: Independent sample t test.

S: Statistically significant if P≤0.05; NS: Not significant.

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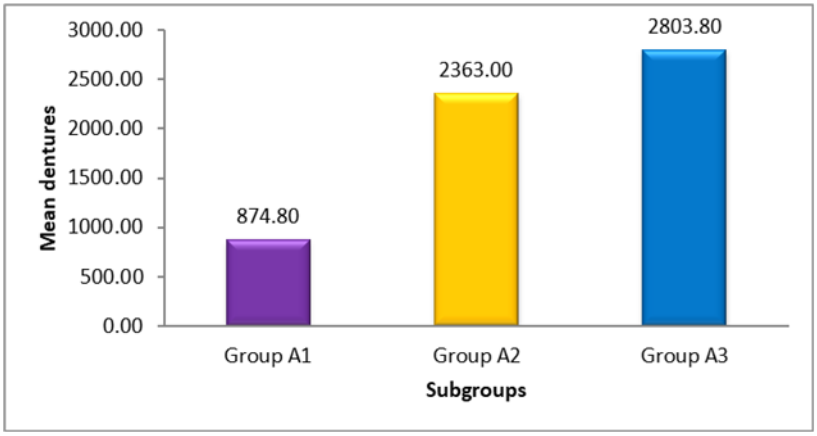
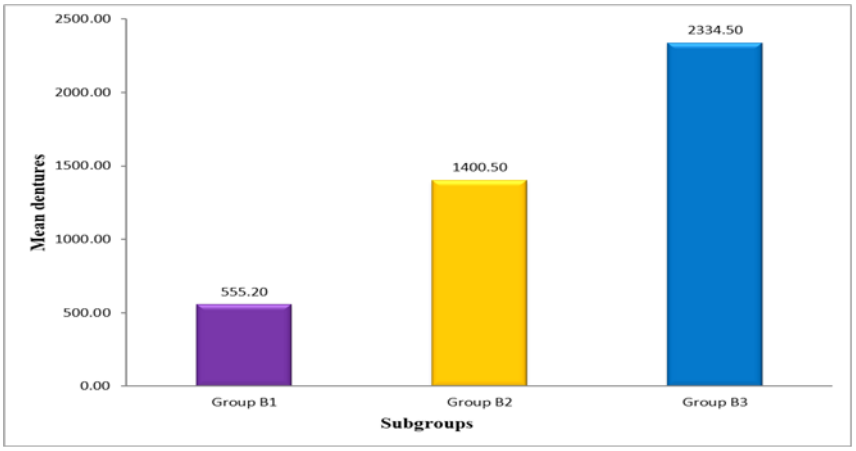
Graphs

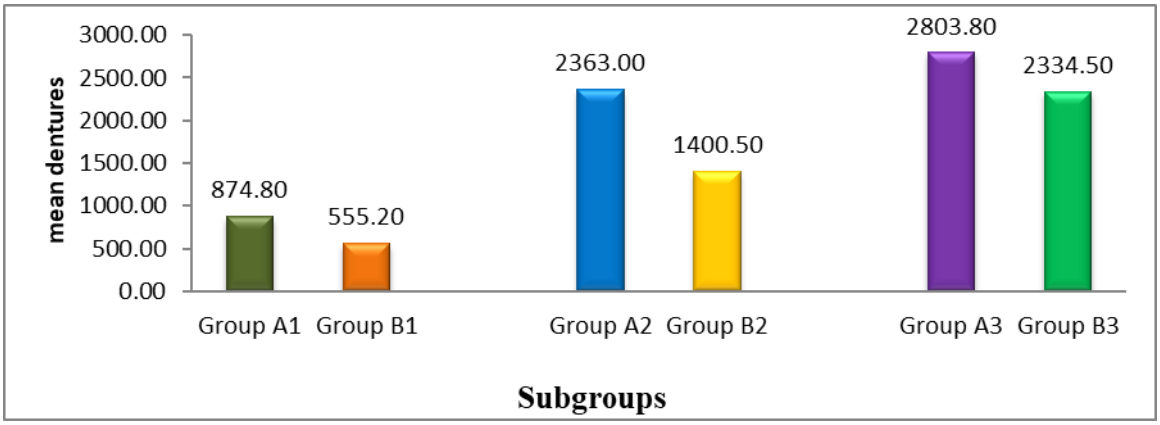
Graph A: Mean comparison of dentures among Sub-groups of Group A



Graph B: Mean comparison of dentures among Sub-groups of Group B



Graph C: Mean comparison of retention of dentures between Group A and Group B



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Figures

Figure 1a and 1b: Maxillary and Mandibular complete dentures

Figure 2: Canine – tuberosity point

Figure 3: Maxillary complete denture with loop

Figure 4: Existing maxillary denture

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Figure 5: Trimming of borders by 1-2mm

Figure 6: Retention measuring apparatus

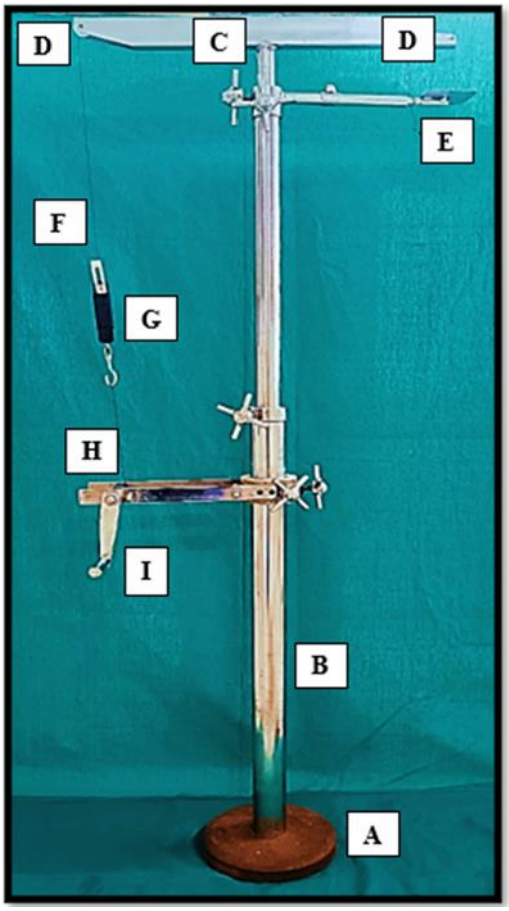

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Figure 7: Digital hanging weight measuring scale

Figure 8a and 8b: Measuring of retentive force using the specially designed apparatus & cephalostat. a Frontal view. b Profile view

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