

Evaluation and Comparison of Retention of Implant Retained Mandibular Overdenture Based on Different Attachments and Locations: An Invitro Study

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ABSTRACT

Background: To evaluate and compare the retention of implant retained mandibular overdenture based on different attachments and locations.

Materials and method: A completely edentulous mandibular cast was studied and surveyed to ensure absence of undercut and was finished and polished. Duplication of the cast was done using alginate (Algitek DPI, India) and was poured by modelling wax. Now, the wax model was flaked and processed for the fabrication of the Heat Cure acrylic study model.

Ball Attachment (Height 2mm, NM-T1202 Noris medical) (Fig. 6) and Flat Attachment (Height 2mm, NM- T1102 Noris medical) (Fig. 7) was used in the study. The attachments were screwed with the help of Star Hex Screw Driver (Length 14mm NM-X7007, Noris medical) on the implant analogs and caps of both ball attachment (Fig. 8) and flat attachment (Fig. 9) were placed on their respective attachments and their height and diameter was measured by using Vernier Caliper.

Result: The present shows that the mean retention of mandibular overdenture with implants at A B D E position achieved by Ball attachment was 634.6 N, which was significantly higher than that of Flat Attachment 194 N at same position.

Conclusion: The retention of mandibular overdenture by Ball and flat attachment at A and E position was found to be more than that of Ball and flat attachment at B and D position.

Keywords: Implant, Overdenture, location.

INTRODUCTION

Edentulism is defined as the state of being edentulous; without natural teeth.¹ Due to the loss of teeth it effects the person's function, esthetic and health, which reduces the efficiency of the masticatory muscles affecting the nutrition of an individual which makes him vulnerable to many diseases. So, it is a common health problem which has to be focused. Wright has documented that in 1998, the Adult Dental Health survey was conducted and showed about 1-2% of the sample becoming edentulous in the preceding decade.

Projections show there will be about 2 million complete denture wearers in 2018.²

The percentage of elderly individuals in the population has been increasing in a number of countries indicating that the demand for treatment for edentulism will also increase. Among different countries India has a higher edentulism prevalence rate of 16.3%.³ A survey of elderly patients showed that 66% were dissatisfied with their complete dentures. The main reason for dissatisfaction were

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discomfort, poor fit, retention, soreness and pain, especially with mandibular dentures.⁴ In the present study Ball and Flat attachment systems are used in different position in the mandible. This study aim to evaluate and compare the retention of implant retained mandibular overdenture based on different attachments and locations.

Aim:

To evaluate and compare the retention of implant retained mandibular overdenture based on different attachments and locations.

Objectives:

1. To evaluate the retention of mandibular over denture with implants in B and D position by ball attachment.
2. To evaluate the retention of mandibular over denture with implants in B and D position by flat attachment.
3. To evaluate the retention of mandibular over denture with implants in A and E position by ball attachment.
4. To evaluate the retention of mandibular over denture with implants in A and E position by flat attachment.
5. To compare the retention of mandibular over denture with implants in B and D position, A and E position achieved by ball attachment.
6. To compare the retention of mandibular over denture with implants in B and D position, A and E position achieved by flat attachment.
7. To compare the retention of mandibular over denture with implants in B and D position achieved by ball and flat attachment.
8. To compare the retention of mandibular over denture with implants in A and E position achieved by ball and flat attachment.

MATERIALS AND METHODS

Materials:

1. Dental plaster (Plaster of paris Neelkanth Dentico Finechem LLP, India)
2. Type III Dental stone (Denstone Pankaj Enterprises, India)
3. Modelling wax (Y-Dent MDM Corp. , India)
4. Alginate (Algitek DPI, India)
5. Cold mould seal (Prodent, India)

6. Self cure acrylic resin (Pyrax RAPID REPAIR self polymerizing resin, India)
7. Heat cure acrylic resin (Trevalon denture base material Dentsply, India)
8. Elastomeric impression material (FLEXCEED GC, India)
9. Stainless steel wire (21 Gauge SMITH, UK)
10. Pumice (Safe Plus pumice powder Neelkanth, India)
11. Implant analog (Diameter 4.0 mm, Height 12.7 mm NM-T6004 Noris medical, Israel)
12. Ball Attachment (Height 2mm, NM-T1202 Noris medical, Israel)
13. Flat Attachment (Height 2mm, NM- T1102 Noris medical, Israel)
14. Cap for ball attachment with Cap insert (Diameter 2.5 mm NM-T300, NM- T3004 Noris medical, Israel)
15. Cap for flat attachment (Standard silicon NM-T3017 Noris medical, Israel)

Armamentarium:

1. Rubber bowl
2. Plaster spatula
3. Flask (Jabbar, India)
4. Clamp
5. Star Hex. Driver (Length 14mm NM-X7007, Noris medical, Israel)
6. Vernier Caliper
7. Tungsten carbide bur (DFS, Germany)
8. Straight fissure bur (DFS, Germany)
9. Precision milling unit (Paraskop M, Bego)
10. Surveyor (Marathon - 103 Saeyang Company)
11. Universal Tensile Tester (SAMARTH, Range- 0.01 N- 500N)

Method:

A completely edentulous mandibular cast was studied and surveyed to ensure absence of undercut and was finished and polished. Duplication of the cast was done using alginate (Algitek DPI, India) and was poured by modelling wax. Now, the wax model was flaked and processed for the fabrication of the Heat Cure acrylic study model (Fig. 1).

The interforaminal positions purposed by Carl .E Misch for implant supported mandibular overdenture had been determined in the study model and then the A, B, C, D, E positions were marked (Fig. 2).

Implant analog of size (Diameter 4.0 mm, Height 12.7 mm NM-T6004 Noris medical) (Fig. 3) had selected. The model was then oriented on the Precision Milling Unit (Paraskop M, Bego) (Fig. 4) to avoid any fault in the angulation of insertion, so that parallelism would be maintained in between implants. Straight fissure bur (DFS, Germany) and tungsten carbide bur (DFS, Germany) were inserted simultaneously in the milling spindle of Precision milling unit.

Drilling was done on marked positions in the oriented model placed on Precision Milling unit. After drilling the selected implant analog was inserted in the respective positions with the help of Self cure acrylic resin (Pyrax RAPID REPAIR self polymerizing resin, India) (Fig. 5) and was fixed into that position.

Ball Attachment (Height 2mm, NM-T1202 Noris medical) (Fig. 6) and Flat Attachment (Height 2mm, NM- T1102 Noris medical) (Fig. 7) was used in the study. The attachments were screwed with the help of Star Hex Screw Driver (Length 14mm NM-X7007, Noris medical) on the implant analogs and caps of both ball attachment (Fig. 8) and flat attachment (Fig. 9) were placed on their respective attachments and their height and diameter was measured by using Vernier Caliper (Fig. 10,11).

According to the height and diameter of attachment used, the wax was build on the implant location to create space for the attachment in the Acrylic framework (Fig.12) and then it was duplicated by using alginate (Algitek DPI, India) and was poured in dental stone.

The cast with the space for attachment system was finished and then double layer of modelling wax was adapted to the cast for the fabrication of Acrylic Framework and vestibular sulcus was also filled with modeling wax for proper border of the Acrylic Framework. A stainless steel loops were made and were affixed on the implant location in the modeling wax, which was used for pulling the Acrylic Framework for measuring retention.

A putty index was made with loop placed on modelling wax applied on the cast to ensure same position of loops to be placed for fabrication of another acrylic framework for different attachment.

Fabrication of acrylic framework was done by following all processing steps, flasking, dewaxing and packing with heat cure acrylic resin (Trevalon denture base material Dentsply, India), followed by curing.

Two acrylic framework with loops on the polished surface and space for Cap of ball Attachment and Flat Attachment in the intaglio surface were finished polished. The intaglio surface of the acrylic framework with space for the cap of the attachment system was fixed by using self cure acrylic resin. First, the ball attachments were screwed to the implant analog and the caps of the attachment was fixed on the attachment. The undercut formed between attachments were blocked. Then Acrylic framework with cap of the ball attachment was picked up by using Self Cure Acrylic resin.

Following the similar procedure Acrylic Framework with cap of the Flat Attachment was picked up.

Retention was checked by using universal testing machine with a cross head speed of 51mm/sec which is same as masticatory cycle.

For evaluating retention at B and D position, first the Ball attachments were screwed at B and D position in the model with their Acrylic Framework placed over it. Then model was fixed to the jig of universal testing machine. For recording the retention, 20 readings were recorded.

For evaluating retention at B and D position by Flat attachments. Attachments were screwed at B and D position in the model with their Acrylic Framework placed over it. Then model was fixed to the jig of universal testing machine. For recording the retention, 20 readings were recorded.(Fig 13).

For evaluating retention at A and E position, first the Ball attachments were screwed at A and E position in the model with their Acrylic Framework placed over it. Then model was fixed to the jig of universal testing machine. For recording the retention, 20 readings were recorded.

For evaluating retention at A and E position by Flat Attachments. Attachments were screwed at A and E position in the model with their Acrylic Framework placed over it. Then model was fixed to the jig of universal testing machine. For recording the retention, 20 readings were recorded. All the

readings obtained were subjected to statistical Analysis.

The present study was done on a model simulating edentulous mandible, in which implant analog were positioned at A, B, C, D, E position and retention was checked by Ball and Flat attachments at different positions and 20 readings at each position was measured by Universal Tensile tester.

These readings were subjected to statistical analysis.

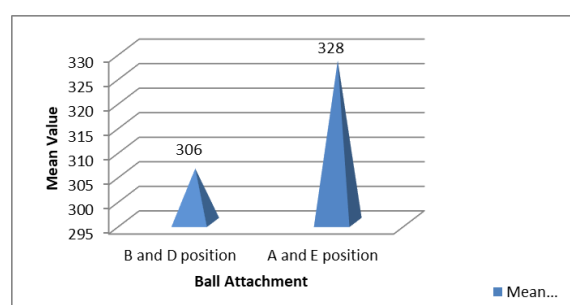
Table 1: Comparison of mean values of Retention in mandibular overdenture achieved by Ball Attachments with implants in B and D position, A and E position.

Ball Attachment	No.	[Mean±SD]	't' value	P value
B and D position	20	306.0 ± 24.1	3.37, df=38	0.002*
A and E position	20	328.6 ± 17.7		

Unpaired 't' test applied. * Significant

The above table shows the comparison of mean value of retention achieved by Ball Attachments with implants in B and D position, A and E position. .

The mean for Ball Attachment at B and D position was 306. While the mean for Ball attachment at A and E Ball position was 328.6. The difference was found to be statistically significant ($P<0.05$), suggesting that retention of Ball attachment at A and E position was significantly more than that of Ball Attachment at B and D position.



Graph 1: Comparison of retention of mandibular implant retained overdenture with implants in B and D position, A and E position achieved by Ball attachment.

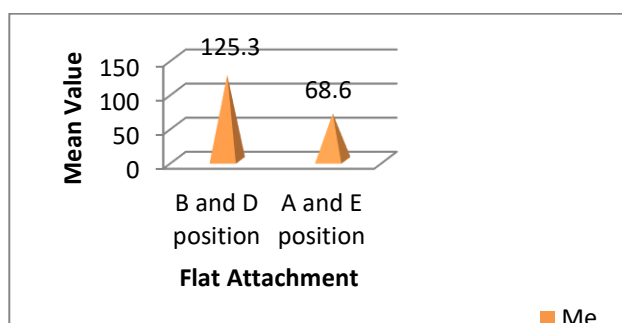
The above graph shows that the mean for Ball Attachment at B and D position was 306. While the mean for Ball attachment at A and E Ball position was 328.6. The difference was found to be statistically significant ($P<0.05$), suggesting that retention of Ball attachment at A and E position was significantly more than that of Ball Attachment at B and D position.

Table 2: Comparison of mean values of Retention in mandibular overdenture achieved by Flat Attachments with implants in B and D position, A and E position.

Flat Attachment	No.	[Mean±SD]	't' value	P value
B and D position	20	125.3 ± 3.97	41.58, df=38	0.000*
A and E position	20	68.6 ± 4.63		

Unpaired 't' test applied. * Significant

The above table shows the comparison of mean value of retention achieved by Flat Attachments with implants in B and D position, A and E position. The mean for Flat Attachment at B and D position was 125.3. While the mean for Flat attachment at A and E position was 68.6. The difference was found to be statistically significant ($P<0.05$), suggesting that retention of Flat attachment at A and E position was significantly more than that of Flat Attachment at B and D position.



Graph 2: Comparison of retention of mandibular implant retained overdenture with implants in B and D position, A and E position achieved by Flat attachment.

The above graph shows the comparison of mean value of retention achieved by Flat Attachments with implants in B and D position, A and E position. The mean for Flat Attachment at B and D position was 125.3. While the mean for Flat attachment at A

and E position was 68.6. The difference was found to be statistically significant ($P < 0.05$), suggesting that retention of Flat attachment at A and E position was significantly more than that of Flat Attachment at B and D position.

DISCUSSION

In the era of development, life expectancy has increased. As tooth loss is directly related to age and due to less awareness in the oral hygiene regimen, the total number of edentulous people within the societies is increasing continuously. As **Douglass and colleagues**⁵ point out that edentulous population exists and will continue to increase. It has been surveyed and estimated that India will have 2 million edentulous people by 2018.² The treatment options for edentulousness are- Conventional denture, Implant supported fixed prosthesis, Removable Implant retained overdenture and Combined implant- retained or soft tissue supported overdenture prosthesis.

Two consensus published in **2002 Mc Gill consensus** and **2009 York Consensus** according to this concept prosthetic rehabilitation with a conventional denture of patient with a completely edentulous mandible should be no longer be the treatment. Instead, the placement of two implants and fabrication of an implant- retained overdenture should be the treatment to be considered first.^{6,7,8} **Chung KH et al**⁹ observed less retention for locator (8.95 N) because of the flat simple geometric configuration and concluded that reduced retention characteristic may be desirable for patients with poor manual dexterity, who may have difficulty in inserting and removing the overdenture.

In the present study mean retention of mandibular overdenture with implants at A and E position achieved by Ball attachments was found to be 328.6 N which was significantly higher than that of Flat Attachment at A and E position 68.6 N. **Scherer MD et al**¹⁰ found more vertical retentive force for ball attachment at P1 region compared to locator attachment. **Michelinakis G et al**¹¹ observed that ball attachments gave the highest retention value 40 N, especially at 29mm.

In the present study the mean retention of mandibular overdenture with implants at A B D E position achieved by Ball attachment was 634.6 N,

which was significantly higher than that of Flat Attachment 194 N at same position. The study done by **Sadr SJ et al**¹² the mean dislodging force at ABDE by ball attachment was found out to be 89 N, which was higher compared to other attachments used in the study. **Alsabeeha NHM Scherer MD et al**¹³ concluded that ball attachment achieved significantly higher retentive forces compared to other attachments.

CONCLUSION

In the present study retention of mandibular overdenture by Ball and Flat Attachment at B and D position, A and E position was evaluated and compared. The present study concluded:

1. The retention of mandibular overdenture by Ball attachment at A and E position was found to be more than that of Ball Attachment at B and D position.
2. The retention of mandibular overdenture by Flat attachment at A and E position was found to be more than that of Flat Attachment at B and D position.
3. The retention of mandibular overdenture by Ball attachment was found to be more than that of Flat Attachment at B and D position.
4. The retention of mandibular overdenture by Ball attachment was found to be more than that of Flat Attachment at A and E position.
5. The retention of mandibular overdenture by Ball attachment was significantly higher than that of Flat Attachment at B and D position, A and E position.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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