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A Comparative Evaluation Of Retention And Stability Of Mandibular Implant-Supported Overdenture With Different Attachment Design: An In Vitro Study

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Abstract:
Statement of Problem: *The location of dental implants and the retentive attachments for implant-retained overdentures are selected based on clinician preference, expert opinion, or empirical information. Limited information is available regarding implant attachment designs, and the effect on the retention and stability of mandibular implant overdentures.*
Aim: *This investigation aimed to evaluate the retention and stability of mandibular implant-supported overdenture with ball and locator attachment designs.*
Material and Method: *A model simulating a mandibular edentulous ridge with 4 dental implant analogs in positions approximating the tooth position in the natural dentition were taken. 4 metal loops were attached on 4 different heat cure denture bases by acrylic resin. Metal chains were used and attached to a universal testing machine on one end and to the loops by other end, Universal testing machine was used to measure peak load (N) required to disconnect the attachment. Retention was evaluated followed by stability of 2 implant-retained overdenture based upon the ball and locator attachment design. After each of the models were subjected to 1440 pulls each to dislodge the overdenture from the acrylic model, For each group, 10 measurements were made by peak dislodging forces. Data were analyzed to determine statistical equivalence among two different attachments paired t-test and independent sample t-test (p = .05)*
Results: *For vertical, anterior, right and left lateral dislodging, group I recorded the highest initial and final retention, and group II recorded the lowest retention. Both the group I and group II shows gradual gradual decreases in retention and stability loss after cyclic loading.*
Conclusion: *Ball attachment recorded the highest initial and final retention and stability (during vertical, anterior, posterior and right and left lateral dislodging) compared to locator attachment. Both the ball and locator attachment show gradual decreases in retention loss after overdenture was subjected to 1440 cyclic loading cycles*

Keywords: *Implant, locator attachment; ball attachment.*

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I. Introduction

Rehabilitating edentulous patients with residual ridge resorption has improved tremendously because of implant dentistry. Implant supported overdentures have expanded rapidly as a successful treatment modality to rehabilitate completely edentulous patients. Overdentures are simply conventional dentures attached to the remaining teeth or dental implants. Several studies have suggested that the use of implant-supported overdentures in the mandible is an effective treatment modality, especially in patients with excessive loss of residual bone.[1]

Three main factors are involved in optimal denture treatment: retention, support, and stability.[2] While there are varied opinions regarding the importance of each of these three factors involved in treatment, it is critical to evaluate and properly estimate their contribution to optimal denture and overdenture function, comfort, and patient acceptance. Retention of artificial tooth substitutes is related to the ability of a prosthesis to resist the forces of dislodgment along the path of insertion or placement of the prosthesis.[3] Retention is often cited as being an important factor in denture treatment whereas stability is reported as being the most important factor.[2],[4] Stability is defined as the resistance to horizontal displacement of a prosthesis and without stability, the effect of retention and support are negated.[5] Support is provided by the tissue surface of the mandibular edentulous ridge. In choosing between treatment approaches, patients often choose the treatment that increases stability even when cost is a major factor. [6]

An attachment is a mechanical device for the fixation, retention and stabilization of a dental prosthesis.[3,8] A variety of attachment systems have been used to retain overdentures. Generally, these can be classified as clips- and- bars, balls, magnets, and telescopic copings (rigid or nonrigid). The selection of an attachment system is mainly related to the clinical condition, availability, choice of practitioner and/or laboratory responsible.[9]

The **Locator attachment**, a nonsplinted system, was introduced by Zest Anchors in 2000 and has been used extensively for implant-retained overdentures. The locator attachment system is type of stud attachment used in patient with atrophic alveolar ridge, less inter-arch space, inadequate denture height. This attachment is self-aligning and has dual retention (inner and outer) and in different colors with different retention values. Locator attachments are available in different vertical heights, they are resilient, retentive, and durable, and have some built-in angulation compensation. Locator attachments come in different colors (white, pink, and blue), and each has different retentive value. Additional features are the extended range attachments, which can be used to correct implant angulation up to 60 degrees they are offered in green, which has standard retention, and red, which has extra-light retention.[10]

Ball attachments for implant overdentures have evolved from the early 1960's. Ball attachments were considered the simplest type of attachments for clinical application with tooth-or implant-supported overdentures. The most common patrix consists of a titanium alloy 2.25 mm diameter ball. In contrast, the matrix is a titanium alloy or stainless steel case with a metallic or plastic retention device.Ball Attachment System can function when implants are parallel or not. Indeed, they have been designed to accommodate changes in implant angulation up to 12, 15, 20, or 30 degrees. The matrix components in the denture must remain parallel to the vertical path of prosthetic insertion.[12]

Ball Attachments are the most widely used Attachment System because they are easy to handle clinically, are relatively economical, and have a lower technique sensitivity.[13] In consideration of the currently available studies, limited information exists regarding different implant attachments i.e., ball and locator, distribution, and number and the effect upon the retention and stability of mandibular implant overdentures.

The purpose of this investigation was to provide an in vitro evaluation of retention and stability of mandibular implant supported overdenture with different attachment designs.

II. Material And Methods

An analogue model of a mandibular edentulous ridge was created, with dental implants placed in locations that roughly corresponded to the positions of natural dentition teeth.

Procedure methodology : The trial denture was used as guide template for marking the exact tooth position by drilling in the middle of the tooth. 4 implant analogs with dimensions of 3.5 x 10.0mm were procured and utilized for the study. Then implant analog were placed in Canine and 2nd Premolar location bilaterally. Analogs were then fixed with clear acrylic for chemical and mechanical retention.

The study was conducted in following two groups:

Group 1 – Ball attachment

Group 2 – Locator attachment

Four attachments of 0.5mm were procured and utilized for the study. 40 Silicone insert and 12 metal caps housing were procured and utilized in the study. 4 implant attachments were secured for all the 2 study groups and were assembled with hex and torqued on implant analogs as per the groups. Silicon inserts were placed and metal housing was assembled on it. Alginate impression was made for each group and stone cast were fabricated. All the 2 stone cast were blocked at the attachments site and overdentures were fabricated using auto polymerizing acrylic These overdentures were then placed on clear acrylic model to check for the fit then all the 4 metal housing were picked up using auto-polymerizing poly methyl methacrylate (PMMA) acrylic resin (vent holes were made for flow out of excess material).

Evaluation of retention: This was done using Universal Testing Machine,to test the force required to dislodge the prosthesis in axial direction. 4 metal hooks were incorporated from the framework at canine and molar region bilaterally. A 15 cm long custom made iron chain was connected to each hook of the overdenture. A metal plate of 5X5 cm dimension with four perforations was joined to the chain end by adjustable screw. The metal plate was connected to the head of a universal testing machine by additional (main) chain in the center of the plate. An axially directed 4 points vertical pull was applied on the metal plate, till separation of attachments occured, and was used to determine retention against vertically directed dislodging force parallel to the path of insertion.

A cross head speed of 50mm/min was used to approximate the denture dislodgement speed during mastication. The maximum load needed to separate the experimental overdenture was recorded in newton (n) to represent the retention force. Each measurement was recorded for all the 2 groups with new nylon insert for 10 consecutive recordings. Subsequently, the overdentures underwent constant removal and insertion on a Universal Testing Machine for 1440 cycles, which replicated a year of use, presuming the patient removes the denture four times daily.

This will be repeated for all attachment designs to evaluate retention in canine and second premolar region.

Evaluation of stability : A 2-point anterior/posterior/oblique pull was used to determine stability and resistance against para-axial, oblique dislodging forces.

Anterior Stability: The tensile force was applied in anterior side when 2 chains attached to the anterior canine and hooks were activated and posterior 2 chains were disconnected and force required to dislodge the overdenture was calculated.

Posterior Stability: The tensile force was applied in posterior side when 2 chains attached to the posterior molar and hooks were activated and anterior 2 chains were disconnected and force required to dislodge the overdenture was calculated.

Lateral Stability: The tensile load was applied in the left direction when the chains are connected to the canine and molar hooks of the right side and left 2 chains were disconnected and force required to dislodge the overdenture was calculated. Same will be done for the right side.

10 measurements will be recorded for all directions of dislodging forces. This will be repeated for all 4 groups to evaluate stability in various location.

Data was tabulated and subjected to statistical analysis for interpretation of results. Paired t-test and independent sample t-test was applied for pairwise comparison. Conclusions were drawn based on the statistical analysis.

Statistical analysis

Data was entered into Microsoft Excel spreadsheet .The data was analysed by SPSS (21.0 version). Paired t−test and independent sample t−test of mean values were performed. The level of significance was set at $p \leq 0.05$.

Fig 1: Ball attachments assembled using hex,

Fig 2: Metal hooks placed at canine and premolar

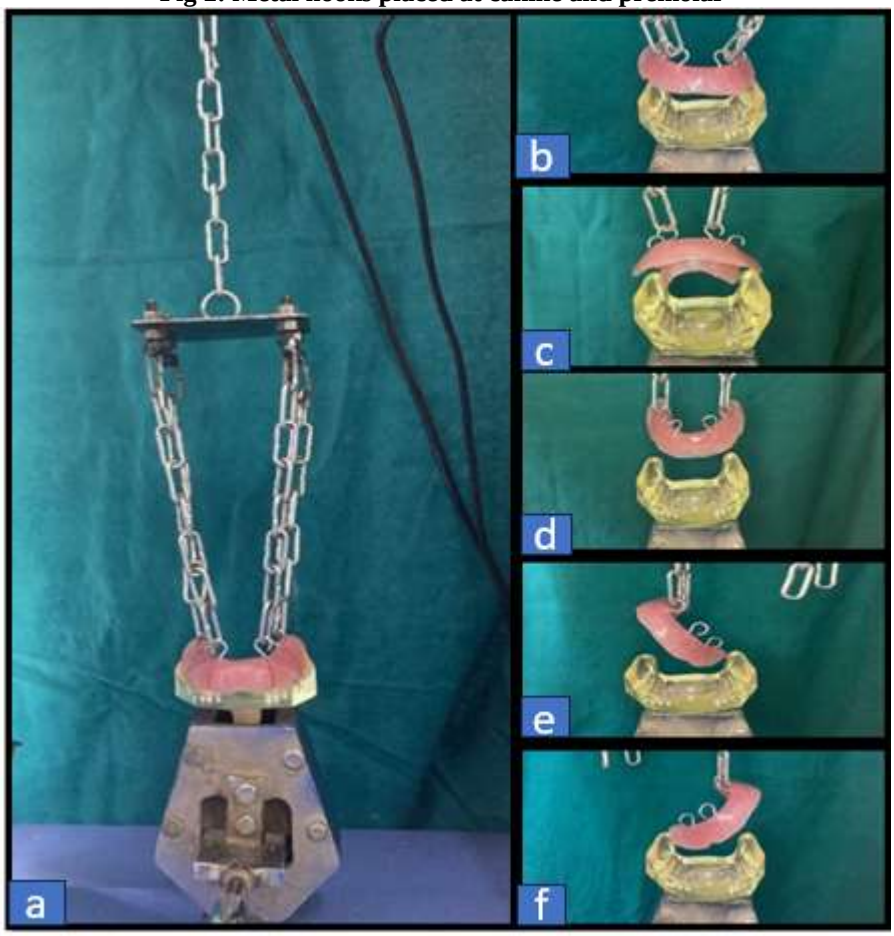

Fig 3 :(a) Master model attached to universal testing machine with metal hooks and metal chains; (b) vertical dislodgement; (c) anterior dislodgement; (d) posterior dislodgement; (e) left lateral dislodgement; (f) right lateral dislodgement

III. Result

Table 1**:** Showed change in retention of mandibular implant supported overdenture between group I and group II. When implant overdenture was subjected to vertical dislodging forces initial mean standard deviation of group, I was 7.84 ±1.29 and final was 5.95±0.86 in group II initial mean standard deviation was 4.84±.27 and final was 3.22±0.31.

Table 1: Change In retention (Vertical Dislodgement (in N)) of Implant supported overdenture with different attachment designs. (group I: ball attachment; group II: locator attachment)

	Measure of peak load of retention (Vertical Dislodgement) of implant placed with different attachment designs			
Specimen No	Ball attachment (group I)		Locator attachment (group II)	
	Initial	Final	Initial	Final
1.	**10.0**	**4.72**	**4.77**	**2.84**
2.	**9.27**	**6.59**	**4.95**	**3.04**
3.	**7.24**	**7.13**	**4.94**	**3.25**
4.	**9.74**	**6.90**	**4.22**	**3.09**
5.	**6.40**	**5.77**	**4.60**	**3.79**

6.	**7.31**	**5.52**	**5.20**	**3.77**
7.	**7.00**	**6.34**	**4.81**	**2.97**
8.	**7.04**	**6.57**	**4.92**	**3.14**
9.	**7.32**	**5.02**	**5.01**	**3.21**
10.	**7.12**	**5.02**	**5.02**	**3.12**
Mean ±S.D	**7.84 ±1.29**	**5.95±0.86**	**4.84±.27**	**3.22±0.31**

Table 2: Showed Change In stability i.e. Anterior, posterior, right lateral, left lateral dislodgement (in N) of implant supported overdenture in group I.

When implant overdenture was subjected to anterior dislodging force initial mean standard deviation was 7.1±.25 and final was 6.27±1.3. When implant overdenture was subjected to posterior dislodging force initial mean standard deviation was 6.99±.41 and final was 5.89±.67. When implant overdenture was subjected to right lateral dislodging force initial mean standard deviation was 5.14±.90 and final was 4.18±.80. When implant overdenture was subjected to left lateral dislodging force initial mean standard deviation was 4.7±.59 and final was 4.39±.62.

Table 2: Change In stability (anterior, posterior, right lateral, left lateral dislodgement (in N) of Implant supported overdenture with ball attachment (group I) designs.

	Measure of peak load of stability of implant supported overdenture with ball attachment design							
Specimen No	**Anterior dislodging**		**Posterior dislodging**		**Right lateral dislodging**		**Left lateral dislodging**	
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	**Initial**	**Final**
1.	**7.36**	**7.75**	**7.15**	**6.86**	**4.79**	**5.02**	**5.65**	**5.22**
2.	**6.81**	**8.29**	**6.86**	**6.58**	**4.84**	**4.02**	**5.20**	**5.13**
3.	**7.47**	**7.36**	**7.22**	**6.40**	**4.62**	**5.25**	**5.27**	**4.84**
4.	**6.88**	**7.09**	**6.47**	**6.70**	**4.80**	**4.81**	**4.09**	**4.38**
5.	**7.00**	**5.79**	**6.92**	**5.31**	**4.81**	**4.97**	**3.59**	**4.88**
6.	**7.27**	**6.45**	**7.02**	**5.68**	**5.00**	**4.02**	**4.92**	**4.11**
7.	**7.36**	**5.36**	**6.74**	**5.70**	**5.25**	**4.11**	**4.59**	**4.14**
8.	**7.45**	**5.05**	**6.43**	**5.29**	**4.78**	**3.06**	**4.91**	**4.21**
9.	**6.87**	**4.52**	**7.23**	**5.09**	**4.67**	**3.23**	**4.76**	**3.02**
10.	**7.21**	**5.02**	**7.86**	**5.29**	**4.89**	**3.31**	**4.75**	**4.02**
Mean±S.D	**7.1±.25**	**6.27±1.3**	**6.99±.41**	**5.89±.67**	**5.14±.90**	**4.18±.80**	**4.7±.59**	**4.39±.62**

Table 3: Showed Change In stability i.e. Anterior, posterior, right lateral, left lateral dislodgement (in N) of implant supported overdenture in group II.

When implant overdenture was subjected to anterior dislodging force initial mean standard deviation was 3.75±.12 and final was 3.19±0.48. Subjected to posterior dislodging force initial mean standard deviation was 3.88±.12 and final was 3.55±.31. Subjected to right lateral dislodging force initial mean standard deviation was 3.88±.15 and final was 2.97±.38. Subjected to left lateral dislodging force initial mean standard deviation was 3.57±.22 and final was 3.18±.32.

Table 3: Change In stability (anterior, posterior, right lateral, left lateral dislodgement (in N)) of Implant supported overdenture with locator attachment (group II) designs.

	Measure of peak load of stability of implant supported overdenture with locator attachment design							
Specimen No	**Anterior dislodging**		**Posterior dislodging**		**Right lateral dislodging**		**Left lateral dislodging**	
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	**Initial**	**Final**
1.	**3.90**	**3.00**	**4.09**	**3.89**	**3.81**	**2.5**	**3.36**	**3.02**
2.	**3.77**	**2.45**	**3.77**	**3.06**	**3.69**	**2.33**	**3.68**	**3.36**
3.	**3.50**	**2.88**	**3.88**	**3.47**	**3.86**	**2.67**	**3.27**	**3.15**
4.	**3.81**	**3.74**	**3.81**	**3.15**	**3.79**	**3.29**	**3.45**	**3.12**
5.	**3.86**	**2.95**	**3.74**	**3.67**	**4.06**	**3.36**	**3.72**	**3.74**
6.	**3.77**	**3.86**	**3.92**	**3.50**	**3.95**	**3.52**	**3.91**	**3.54**
7.	**3.68**	**3.12**	**3.87**	**3.88**	**4.01**	**2.95**	**3.67**	**3.12**
8.	**3.61**	**2.74**	**3.76**	**3.74**	**4.12**	**3.15**	**3.86**	**2.56**
9.	**3.73**	**3.56**	**3.90**	**3.25**	**3.67**	**2.85**	**3.34**	**3.02**
10.	**3.89**	**3.69**	**4.09**	**3.89**	**3.86**	**3.15**	**3.51**	**3.21**
Mean±S.D	**3.75±.12**	**3.19±0.48**	**3.88±.12**	**3.55±.31**	**3.88±.15**	**2.97±.38**	**3.57±.22**	**3.18±.32**

Table 4: showed descriptive statistical comparison of initial and final retention and stability of group I.

When implant overdenture was subjected to vertical dislodging forces mean standard deviation was 6.90±1.45 observed. Subjected to anterior dislodging forces mean standard deviation was 6.72±1.02 observed. Subjected to posterior dislodging forces mean standard deviation was 6.44±.78 observed. Subjected to right lateral dislodging forces mean standard deviation was 4.51±.66 observed. Subjected to left lateral dislodging, forces mean standard deviation was 4.5±.63 observed.

Table 4: Descriptive statistics for change in retention and stability (anterior, posterior, right lateral, left lateral dislodgement (in N)) of implant supported overdenture with ball attachment

	change in retention and stability of implant supported overdenture with ball attachment design (Ball initial vs Ball final)			
Peak load (in N)	**No. of specimens**	**Mean**	**Standard deviation**	**significance**
Vertical dislodging	**10**	**6.90**	**1.45**	**.001**
Anterior dislodging	**10**	**6.72**	**1.02**	**.046**
Posterior dislodging	**10**	**6.44**	**.78**	**.000**
Right lateral dislodging	**10**	**4.51**	**.66**	**.021**
Left lateral dislodging	**10**	**4.5**	**.63**	**.195**

X = mean, SD = standard deviation, *p is significant at 5% level of significance

Table 5: Shows descriptive statistical comparison of initial and final retention and stability of group II.

When implant overdenture was subjected to vertical dislodging forces mean standard deviation was 4.03±.87 observed. When subjected to anterior dislodging forces mean standard deviation was 3.47±.44 observed. Subjected to posterior dislodging forces mean standard deviation was 3.68±.27 observed. Subjected to right lateral dislodging forces mean standard deviation was 3.43±.54 observed. Subjected to left lateral dislodging, forces mean standard deviation was 3.38±.33 observed

Table 5: Descriptive statistics for change in retention and stability (anterior, posterior, right lateral, left lateral dislodgement (in N)) of implant supported overdenture with locator attachment

	change in retention and stability of implant supported overdenture with locator attachment design (Locator Initial vs locator final)			
Peak load (in N)	**No. of specimens**	**Mean**	**Standard deviation**	**significance**
Vertical dislodging	**10**	**4.03**	**.87**	**.000**
Anterior dislodging	**10**	**3.47**	**.44**	**.003**
Posterior dislodging	**10**	**3.68**	**.27**	**.002**
Right lateral dislodging	**10**	**3.43**	**.54**	**.000**
Left lateral dislodging	**10**	**3.38**	**.33**	**.005**

X = mean, SD = standard deviation, *p is significant at 5% level of significance

Table 6: Shows descriptive statistical comparison of initial retention and stability of group I and group II.

When implant overdenture was subjected to vertical dislodging forces mean standard deviation of group, I was 7.85±1.30 and group II was 4.84±.27. Subjected to anterior dislodging forces mean standard deviation of group, I was 7.17±.25 and group II was 3.75±.12. Subjected to posterior dislodging forces mean standard deviation of group, I was 6.99±.41 and group II was 3.86±.10. Subjected to right lateral dislodging forces mean standard deviation of group I 4.84±.17 was and group II was 3.88±.15. Subjected to left lateral dislodging forces mean standard deviation of group, I was 4.77±.59 and group II was 3.57±.22.

Table 6: Descriptive statistics for change in initial retention and stability (anterior, posterior, right lateral, left lateral dislodgement (in N)) of implant supported overdenture with ball and locator attachment design

		Ball attachment (group I)	**Locator attachment (group II)**	**significance**

Peak load (in N)	No. of specimens	Mean	Standard deviation	Mean	Standard deviation	
Vertical dislodging	**10**	**7.85**	**1.30**	**4.84**	**.27**	**.000**
Anterior dislodging	**10**	**7.17**	**.25**	**3.75**	**.12**	**.006**
Posterior dislodging	**10**	**6.99**	**.41**	**3.86**	**.10**	**.014**
Right lateral dislodging	**10**	**4.84**	**.17**	**3.88**	**.15**	**.974**
Left lateral dislodging	**10**	**4.77**	**.59**	**3.57**	**.22**	**.094**

X = mean, SD = standard deviation, *p is significant at 5% level of significance

Table 7: Shows descriptive statistical comparison of final retention and stability of group I and group II.

When implant overdenture was subjected to vertical dislodging forces mean standard deviation of group, I was 5.96±.86 and group II was 3.22±.31. Subjected to anterior dislodging forces mean standard deviation of group, I was 4.18±.80 and group II was 2.97±.38. Subjected to a posterior dislodging forces mean standard deviation of group, I was 5.89±.67 and group II was 3.51±.29. Subjected to a right lateral dislodging forces mean standard deviation of group, I was 4.18±.80 and group II was 2.87±.38. Subjected to a left lateral dislodging forces mean standard deviation of group, I was 4.39±.65 and group II was 3.18±.31.

Table 7: Descriptive statistics for change in final retention and stability (anterior, posterior, right lateral, left lateral dislodgement (in N)) of implant supported overdenture with ball and locator attachment design.

		Ball attachment (group I)		Locator attachment (group II)		significance
Peak load (in N)	**No. of specimens**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	
Vertical dislodging	**10**	**5.96**	**.86**	**3.22**	**.31**	**.001**
Anterior dislodging	**10**	**4.18**	**.80**	**2.97**	**.38**	**.001**
Posterior dislodging	**10**	**5.89**	**.67**	**3.51**	**.29**	**.001**
Right lateral dislodging	**10**	**4.18**	**.80**	**2.97**	**.38**	**.022**
Left lateral dislodging	**10**	**4.39**	**.65**	**3.18**	**.31**	**.067**

X = mean, SD = standard deviation, *p is significant at 5% level of significance

IV. Discussion

Overdentures have been advocated as a means of preserving the structures associated with mandibular denture support that may augment retention and stability. Rehabilitation of the edentulous mandible with the 4-implant supported overdenture is a well-accepted treatment method with long-term successful outcomes for prosthesis and implants. The prosthetic and attachment system factors of successful mandibular implant overdentures have been extensively reported in the literature. Bone loss after complete edentulism, especially in the mandible, has been observed for years in the literature. Soft tissue abrasions and accelerated bone loss are more symptomatic of horizontal movement of the prosthesis under lateral forces. An implant-supported overdenture may limit lateral movements and direct more longitudinal forces. As ridge resorption occurs, the mandibular anatomy may affect available implant locations. Implant attachments and its effect on retention and stability of mandibular overdentures is very important[37].

In order to achieve retention and stability of overdentures, different attachment systems can be utilized. An attachment system is defined according to the glossary of maxillofacial implants as "a design of a particular type of retentive mechanism employing compatible matrix and patrix corresponding components. Matrix refers to receptacle component of the attachment system, and patrix refers to the portion that has functional fit and engages the matrix". (Glossary of implant terms, 2007) The prominent attachment systems are bar, ball, magnet types, and several individual mechanical attachments similar in size and function to the ball type. Generally, the selection of an attachment system depends on the experience and preference of practitioners (Kim et al.,

2012).[38] The retentive force of the attachments is gained through either mechanical interlocking, frictional contact or magnetic forces of attraction between the patrices and matrices (Becerra & MacEntee, 1987).

Ball attachment connectors are widely used because of their economical, efficient, and straightforward design. The high-profile abutment of this system is its only drawback, as it may restrict its application, particularly in individuals with narrow jaw anatomy. Cost is a significant consideration, although in comparison to other attachment types such as Locator, ball attachments are less expensive. (Preiskel, 1996)

Since locator attachment introduction in 2001 by Zest Anchors, located in Escondido, California, USA, the Locator overdenture attachment has grown in popularity and usage. The mechanical connection between the matrix's nylon insert portion and the abutment provides the system with stability. The outer and inner portions of the nylon insert both include and interlock over undercuts in the abutment body, engaging the implant abutment in a dual-retention mechanism.

In the present study, two different attachment systems (ball and locator) have been used to retain a four-implant simulated overdenture. It has been observed that the ball attachment system provides better retentive properties when compared to the locator attachment system. The implants were placed bilaterally at four locations i.e. canine, and 2nd premolar. It was previously observed that the retentive forces were the highest for canine and 2nd premolar region.

When in place in the oral environment, mandibular implant overdentures move in complex ways, typically in 6 directions: occlusal, gingival, mesial, distal, facial, and lingual. Although true unidirectional dislodging forces rarely occur in clinical scenarios, a directional pull testing is an effective way of measuring the retention and stability of a prosthesis during in vitro evaluation.[39] Comparison of retention and stability of Ball and Locator attachment systems shows Ball attachments had the highest mean retentive value when compared to the locator attachments in initial and final i.e. before and after 1440 insertion and removal cycles at canine and 2nd premolar location. The overall maximum retentive force was 10.0 N and 5.20 N for the overdenture retained by ball and locator attachments respectively. The overall minimum retentive force was 6.40N and 4.22N for overdenture retained by ball and locator attachments respectively.[16] Statistically significant differences were found between the attachment systems. This could be attributed to the fact that retentive values of the ball and locator attachments are reduced significantly after multiple pulls. Hence a decline in retentive forces was observed in both the attachments after the 1440 pulls.

The retention of a 4-implant simulated overdenture prosthesis is significantly affected by implant attachment system.

The retention of four-implant supported mandibular overdenture with ball and Locator attachments has not been investigated previously. Initial retention values may indicate clinical predictability and performance and facilitate patient acceptance of a prosthesis. Studies have reported that retention strength between 5 and 10 N may be sufficient for implant-retained overdenture during long- term function to achieve good patient satisfaction. Therefore, the initial retentive forces for tested attachments in this study (10 to 15 N) were within the range of accepted effective retentive force for overdenture. For all tested attachments, final retention forces were significantly lower than initial retentive forces. The highest retention loss was recoded for locator and the lowest retention loss was recorded with ball attachment for vertical and right and left lateral and anterior dislodging, respectively.

The overdenture retained with ball attachments showed highest vertical > anterior dislodging > posterior dislodging > right and left lateral initial and final i.e. before and after 1440 insertion and removal cycles dislodging force than in locator attachment.

Statistics revealed that in both the attachment systems, the highest retentive values were in ball attachment and the lowest were locator attachment. These results indicate ball attachment had shows a significant effect on retentive capacity implant overdenture which is tested.

The results of this study were similar to those found in previous studies with regard to ball and locator attachment system. The results of this in vitro study indicate that implants overdenture placed with ball attachment may be a more-effective in cases of retention and stability i.e. anterior, posterior, right lateral, left lateral than implant overdenture placed with locator attachment.[12]

However, these findings do not consider the clinical reality of managing patients who are edentulous. The testing performed is limited by specific conditions and methods that do not completely replicate the clinical situation. The clinical reality of the implant overdenture is much more complex than a laboratory setting can replicate.

V. Conclusion

Within the limitation of this study, it was concluded the comparison between groups:

Ball attachment recorded the highest initial and final retention and stability (during vertical, anterior, posterior and right and left lateral dislodging) compared to locator attachment.

Both the ball and locator attachment shows gradual decreases in retention loss after overdenture was subjected to 1440 cyclic loading cycles.

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