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*Original Article*

# Effect of Different Degrees of lingual Implant Inclination on the Retention of Locator Retained Mandibular Implant Overdenture. An *In-Vitro* Study

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## Abstract

**Purpose**: This study was condacted to evaluate and compare different degrees of lingual implant inclination on retention of locator attachments used for two implant retained mandibular overdentures .**Materials and Methods**: Four acrylic resin models representing acompletely edentulous mandibular ridges were used. Each model received two implants inserted at canine area bilaterally with different degree of lingual inclination. Group I (control Group) 00, Group II (100), Group III (200), and Group IV (300). The residual ridge and the retromlar regions for each acrylic resin model were covered by auto-polymerized silicon material to simulate the oral mucosa. Four experimental acrylic metal reinforced overdenture were fabricated and connected to the implants using Locator attachments, Universal Testing Machine was used for measuring initial and final retentive force, The **Results**: Locator transparent, 00 inclination and anterior dislodging recorded the highest retentive forces, while Locator blue 100 inclination and vertical dislodging recorded the lowest retention values. Conclusions: For majority of groups, inserts, dislodging forces, initial retention recorded significant higher values than final retention.

**Key word**: Overdenture, Locator attachment, retention test.

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## Introduction:

The use of ossointegrated implants has evolved rapidly over the last decade. Research in the oral implantology has led to refinements resulting in high successful and predictable restorative options for partially as well as completely edentulous patients. (1) The implant assistant overdentures have been widely used to solve these problem by improving retention and stability of conventional complete dentures.it also improves neuromuscular activity and adaptation and therapy substantially improves masticatory function in edentulous patients(2 ) The mandible overdentures supported by two implants placed in the interforaminal region

have been well documented in clinical investigations and have been suggested as standard treatment for the edentulous patient. (3) However, implant attachments improves support, stability, and retention of these overdentures and increases patient satisfaction.

Several types of retentive attachments are mainly classified into splinted anchorage systems, such as the bars, and un-splinted anchorage systems, such as the ball anchor, Magnets, Telescopic and Locators attachment (4)The Locator attachment system is increasingly popular attachment system used and was introduced in 2001. This attachment is self-aligning, has dual retention, and is available in different colors with different retention values (5). In addition, repair and replacement are easy and fast. (6)

Studies have shown that retention is influenced by attachment type and design component wear,(7,8) and implant angulation. Predictably, retention has been shown to have a great impact on patient satisfaction. It is appropriate to evaluate retention of attachments after over denture insertion, and not limit it to assessment of initial retention. (9) Retentive device will serve little clinical purpose if due to fatigue it will lose its retention after few weeks. Therefore, fatigue behavior is a critical characteristic of overdenture attachments. Swartz used the universal testing machine (UTM) to clinically test the retention of various denture base materials. The UTM was attached to a hook in the center of the denture base by means of a wire running through arranged pulleys.

Therefore, the aim of this study was to evaluate and compare the effect of different degrees of lingual implant inclinations on retention of two implant retaining mandibular over denture with Locator attachment. The evaluation will be performed using retention attachment analysis.

Materials and methods: Four clear resin acrylic mandibular models representing completely edentulous ridge were fabricated. A clear acrylic guide template for implant placement was fabricated was mounted on resin model. Two holes in canine region marked by using drilling of milling machine. The template was removed and two recesses were prepared in the marked placement sites at same regions. According to the different degree of lingual implant inclination, The models were classified into four groups as follows Group I (Control): Recess were prepared to each other and vertical to the crest of residual ridge at 0 degree lingual implant inclination. Group II Recess was prepared at 10 degree implant inclination toward the midline. Group III Recess was prepared at 20 degree implant inclination toward the midline. Group IV Recess was at 30 degree implant inclination toward the midline.

Each implant recess inclination was established by pivoting the table of the milling device labial-lingual to make the long axis of each drill corresponds to the degrees of the proposed implant inclination (Fig.1). Two laboratory implants (4.6 mm in diameter and 10mm in length) were inserted in each model with the help of Locator abutments that was screwed in the internal hex of the implants to obtain the following degrees of lingual implant inclination. The mucosal simulation was fabricated for each model then totally the four mandibular edentulous experimental overdentures were performed. The metal housing was picked-up on each experimental overdenture.

## Measurement of vertical dislodging forces (retention):

Each model was put on the compression grip of the universal testing machine and

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secured in position with the occlusal plane in a horizontal position. Four chains were screwed to the crosshead of the machine. On other hand they were connected to the four overdenture hooks. (15,16) The crosshead speed was adjusted at 51mm/min, which would approximate the rate of overdenture movement during mastication. The dislodging forces of the vertical (4-point pull) was directed to the path of withdrawal of the housing and the framework (Fig.2).. Maximum load (intial retentive force) needed to dislodge the experimental overdenture from the mandibular test model was calculated. To simulate repeated insertions and removals of the four hooks overdenture over a 6-month period (assuming three daily removals and insertions of the overdenture for purposes of hygiene), each overdenture was pulled out manually 540 times. The tests were repeated five times and the mean of initial and final retentive values (in Newton) was subjected to statistical analysis.

Fig.(4)vertical dislodging force


Fig. (1) Group I (50) implant inclination;Group II (100) implant inclination

## Result:

**Table 1**: Comparison of initial retentive forces between different implant inclinations and between different nylon inserts for posterior dislodging

| | Locator blue | Locator Pink | Locator transparent | Locator Red | Locator Green | F value | 2-way ANOVA |
|---|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | SD | X | SD | X | SD | X | SD | X | SD | | |
| **$0^0$** | 12.17 A,a | 2.04 | 22.12 A,b | 2.02 | 32.01 A,c | 1.00 | | | | | 514.289 | .00* |
| **$10^0$** | 3.86 B,a | .38 | 3.52 B,b | .47 | 21.24 B,c | 1.08 | | | | | 416.270 | .00* |
| **$20^0$** | 5.44 C,a | .51 | 4.62 C,b | .54 | 7.50 C,c | .50 | | | | | 4.858 | .00* |
| **$30^0$** | 3.65 D,a | .57 | 19.39 D,b | .53 | 19.01 D,a | 1.00 | 8.45 a | .51 | 23.14 b | 1.03 | 90.079 | .00* |
| **F value** | 49.841 | | 436.704 | | 546.466 | | | | | | | |
| **2-way ANOVA** | .00* | | .00* | | .00* | | | | | | | |

X= mean, SD= standard deviation, *= P is significant at 5% level of significance. Different upper case letter within the same column indicate a significant difference between groups. Different lower case letter in the same row indicate significant differences between nylon inserts

**Table2**: Comparison between retentive forces of different force directions

| | | F value | 2-way ANOVA | Post hoc test (Bonferroni) |
|---|---|---|---|---|
| **Vertical (X±SE)** | 24.86±.088 | 11855.786 | 0.00* | A |
| **Anterior (X±SE)** | 34.79±.088 | | | B |
| **Posterior (X±SE)** | 12.72±.088 | | | C |
| **Lateral (X±SE)** | 13.77±.088 | | | D |

X= mean, SE= standard error, *= p is significant at 5% level of significance. Different letters indicate a significant difference between force directions

**Table3**: Comparison between retentive forces of different times of measurements

| | F value | | Paired samples t-test |
|---|---|---|---|
| **Initial retention (X±SE)** | 24.41±.062 | 9176.701 | 0.00* |
| **Final retention (X±SE)** | 17.656±.062 | | |

X= mean, SE= standard error, *= P is significant at 5% level of significance. Different letters indicate a significant difference between times of measurements

## Discussion

The following degrees of implant inclination were used: 0, 10, 20 and 30 degrees. Similar degrees of implant inclinations was also recommended in other studies(9-11) conducted to evaluate the effect of different implant inclinations on peri-implant stresses and retention forces and peri-implant strains of different overdenture attachments. Similarly, ELsyad, et al (12-13) used a protractor to detect the degree of mesial, distal and buccal implant inclination of 2 implant retained overdentures using a similar methodology.

During vertical and anterior dislodging, 30o recorded the highest initial retention forces and 20o recorded the lowest forces. Similarly, Rabbani et al. (14) noted an increase in the retention of locator inserts by the increase in the degree of mesial implant inclination of 2 implants retaining overdentures. They attributed the increased retention to the directly opposing mesial undercuts created by the mesial implant which provide increased resistance to vertical dislodgement because the patrices had to be removed in unison and no "weak side" existed from which the patrices could more easily escape10. In our study, the lingual created undercuts by lingual inclination of Locator abutments create more resistance to vertical and anterior dislodgement as these forces applied perpendicular to the locator abutments. Therefore, an increase in the retention was noted with increased implant angulation.

During posterior and lateral dislodging, 0o recorded the highest initial retention forces and 20o recorded the lowest forces. Since no previous published studies concerned with evaluation of the effect of implant angulation on stability (resistance to paraaxial disloadging) of implant overdenture attachments, direct comparison of these findings to the results of other studies was not possible. However, it may be concluded that the initial stability of inserts increased with parallel implants.During vertical dislodging, 30o recorded the highest final retention forces and 20o recorded the lowest forces. The increased final retention with 30o inclination may be due to the excessive buccal undercuts created between the matrix and the patrix of locator attachments placed on 30o inclined implants. These undercuts may interlock the nylon inserts with buccal surfaces of the locator abutments and prevent escapement of locator inserts during vertical dislodging as stated earlier. However, in clinical situation the use of regular nylon inserts with higher implant angulation, although not affect the retention, it may be associated with higher peri-implant strains(11-12) which may cause bone microdamage and resorption(13).

During posterior dislodging, 0o recorded the highest final retention forces and 30o recorded the lowest forces. Posterior rotational dislodgement of overdenture is one of the most anticipated movements(14), associated with implant (teeth) loading and lower patient satisfaction. Therefore, it is desirable to minimize or eliminate it. Posterior dislodgement occurred clinically when mandibular overdenture's distal

extension base lifting off the tissues during function or eating sticky food(15-16-17).

During lateral dislodging, 30o recorded the highest final retention forces and 10o recorded the lowest forces. The decreased retention with 10o may be due to undercuts created by 10o buccal implant inclination are moderate and enhance the wear of the nylon inserts rapidly. This allow nylon inserts to escape easier from undercuts with 10o inclination than 30o inclination. Even if wear/damage of the nylon inserts occurred with large implant angulation (30o), excessive undercuts still provide increased retention(13).

Except anterior dislodging, the highest initial and final retention and stability forces were recorded with Locator transparent, followed by locator pink then locator green, locator red and the lowest retentive forces were recorded with Locator blue. In agreement with this finding, Rabbani et al.13 in a recent study, noted that the greatest percentage of reduction was seen for the blue insert after 720 cycles (6 months of simulated use) for mesially angled implants of one (0/100) or the 2 implants (5/5o) inserted in aluminum blocks, and the transparent insert showed the highest retentive values with all angulated models. It can be concluded that, clinically, the best option in terms of cost effectiveness may be the transparent insert with parallel and moderate implant inclination(18).

With exception of red inserts, anterior dislodging recorded the highest initial retention and posterior dislodging recorded the lowest initial retention. For green, pink, and blue inserts, anterior dislodging recorded the highest final retention and posterior dislodging recorded the lowest final retention. For transparent inserts, anterior dislodging recorded the highest retention and lateral recorded the lowest. For pink inserts, vertical dislodging recorded the highest and lateral recorded the lowest.

Only for transparent and pink inserts for 30o angled implants during vertical and lateral dislodging and for 20o angled implants during posterior dislodging, final retention recoded significant higher retention than initial retention. For all other groups, inserts, dislodging forces, initial retention recorded significant higher values than final retention. This finding is not surprising and is in accordance with previous in vitro investigations. (19-25)

Conclusion: 30o lingual implant inclination recorded the highest initial and final retention forces and 20o recorded the lowest forces. 0o recorded the highest initial and final stability against posterior dislodging and 30o recorded the lowest stability. 30o recorded the highest stability against lateral dislodging forces and 10o recorded the lowest forces. For (initial and final) the anterior dislodging retention recorded the highest while posterior dislodging recorded the lowest retentive forces. However the initial retention forces recorded significant higher values than final retention

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