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### Evaluation of Bone Height Changes Around Implants with Two Different Attachments in Mandibular Implant Overdentures

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#### **Abstract**

The aim of study is to compare the bone height level around the implant in implant supported overdenture with two different attachment (Locator attachment and OLS attachment). The result revealed the lowest bone loss with the OLS attachment with PEEK retentive matrix was reported with overdentures. While the highest bone loss was reported during the second 6 months and within the first year with overdentures with Locator attachment with nylon retentive matrix.

**Keywords:** Locator attachment, Implant supported, overdenture, PEEK , Bone height .

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## **Introduction**

Edentulism is considered a bad outcome for wellbeing and can affect the quality of life. The edentulous patient's prosthetic management has long been a significant problem for dental practice<sup>(1)</sup>.

One of the key reasons for the procedure of prosthodontics is to regain masticatory function which was damaged due to the loss of teeth. In general, patients wearing traditional dentures complain about the instability of the prosthesis, aesthetics and patient satisfaction. Dental implants and implant-supported prosthesis placement have been found to remarkably minimise bone loss in the edentulous mandible as well as facilitate distal bone deposition to implants<sup>(2)</sup>.

Bone preservation is considered one of the most significant aspects that can be achieved by overdentures aided by teeth or implants.<sup>(3)</sup>

In addition, implant with attachment used together to improve the retention, the stability and support of overdenture, so extending their longevity<sup>(4)</sup>.

The attaching mechanism for an implant-retained overdenture should be chosen with taking into consideration the following items: cost effectiveness, amount of retention needed, amount of available bone, expected level of oral hygiene, patient's social status, patient's expectation, maxillo-mandibular

relationship, status of antagonistic jaw and inter-implant distance<sup>(5)</sup>.

Locator attachments were found to be more advantageous than ball and bar systems regarding rate of complications in clinical practice. They are resilient, retentive, durable, and have some built-in angulation compensation. Moreover, repair and replacement are fast and easy. Locator attachments seem to function moderately well, but long-term evaluation is guaranteed<sup>(6)</sup>.

Due to its strong mechanical and physical properties, polyetheretherketone (PEEK) material has been considered an ideal partner for prosthetic dentistry and implantology. PEEK has demonstrated a dignified versatility with high mechanical wear resistance and high tensile, fatigue and flexural strength. PEEK is used to produce high quality plastic components which are thermo-stable, electrically and thermally insulating. The longevity of any implant prosthesis depends on successful osseointegration and implant stability. CBCT radiography has also been used extensively for the follow-up of dental implants and is considered one of the tools for assessing implant success<sup>(7)</sup>.

This study was conducted to investigate the effect of two attachments with different designs and retentive matrix materials; namely locator attachment with nylon cap and OLS attachment with PEEK cap, on marginal bone height surrounding the implants after 6 and 12 months of function.

## **Materials and Methods**

### **Patient selection:**

The patients had angle class-I maxillo-mandibular relationship, were edentulous for at least 6 months before implant placement, had sufficient inter-arch space (>13 mm), free from any systemic diseases that could affect the neuro-muscular behavior, free from systemic diseases that might affect osseointegration e.g. uncontrolled diabetes, free from any TMJ disorders or Para-functional habits. Patients who only motivated and co-operative were included in the present study.

### **Patient Examination:**

Patients were examined extra-orally and intra-orally. The residual ridges which had enough height, width, covered with normal thickness of muco-periosteum, and showing no signs of inflammation or ulceration were only indicated. Tongue size, position and color were also assessed.

### **Construction of Complete Dentures**

Study casts were produced from primary alginate impressions(Cavex Holland B.V, P.O.Box 852-2006 R W Harrlem,) Holland. for the upper and lower arches of each patient. Acrylic resin special trays were constructed on the diagnostic casts and used in recording the final impressions using rubber base impression material(Rubber base Zhermack (Rovigo) – Italy) Master casts were obtained and occlusion blocks were constructed for jaw relation registration, followed by mounting of the master casts on the

articulator. Setting-up of cross linked acrylic resin teeth was done. Try-in was performed, after which the dentures were processed following conventional techniques using high impact acrylic resin.

### **Implant Placement**

The finished lower denture was duplicated for each patient and processed in clear acrylic resin in order to construct a surgical guide template to facilitate implant placement during surgery. The utilized implants were tapered root form, screw implant(Neobiotech Dental Implant, Korea.)3.5mm in diameter and 10 mm in length.

Using sequential drilling after flap reflection, implants were positioned in the inter-foraminal region with the aid of the surgical guide. The drilling path was held buccolingally perpendicular to the bone and halfway, taking into account the parallelism between the two implants. After insertion of the cover screws, suturing was completed.

### **Overdenture Pick-up**

After 3 months, second stage surgery was performed and the cover screws were removed and replaced with a stud attachment randomly dividing the patients into two equal groups: **Group I:** receiving mandibular overdentures retained by locator attachment(Zest Anchors Inc.,Escondido, CA, USA.) with nylon retentive cap (**FIG 1**) and **Group II:** receiving mandibular overdentures retained by OLS(Osteoseal dental implants, California, USA.) attachment with PEEK retentive caps (**FIG 2**).

The caps and housings were secured firmly over the both attachments in each group. Holes corresponding to the housings were drilled in the fitting surface of the denture to allow seating of the denture without any interference with the housings

Duralay (inlay pattern resin) was placed in the relieved areas of the denture and the denture was seated in the patient mouth. The duralay was left to polymerize while the patient was closing in centric jaw relation with gentle pressure. The overdenture was removed, trimmed and polished with the housings picked up in its fitting

surface. The dentures were delivered and oral hygiene instructions were given to the patients.



Fig 1: locator attachment inside patient's mouth (up), housing cap assembly of locator attachment (down).



Fig 2: OLS attachment inside patient's mouth (up), housing cap assembly of OLS attachment (down).

### **Bone height evaluation**

CBCTs were performed immediately after denture prosthetic loading, 6 and 12 months after implant loading in order to assess any marginal alveolar bone height changes. It also correctly measured the distances between the observed crestal bone level and the shoulder of the dental implant.

- CBCT images were acquired at standardised settings using the i-CAT next generation. During X-ray treatment, patients were told not to move. DICOM data was moved to another workstation after image acquisition; images were displayed using Blue Sky Plan<sup>®</sup> software (Blue Sky, IL, USA). Reconstructed panoramic images were created by drawing the panoramic curve on the axial image and then used to measure the

bone level on the mesial and distal aspect of the implant .

- After that the cross sectional images were created parallel to the implant long axis in order to measure bone level on the implant buccal and lingual aspects fig (3).
- The coronal section was modified on the axial image to move through the examined implant, and then mesially and distally assessed bone levels on the corrected coronal image.



**Fig 3: Bone height measurement.**

**Result:**

In group I (Locator): comparison between three intervals was performed by using One Way ANOVA which revealed significant difference between them regarding all surfaces and total (P<0.05),

followed by Tukey’s post hoc test for multiple comparisons which revealed significant difference between 1<sup>st</sup> 6 months and other intervals (P<0.05, mean difference with different superscript letters) in all surfaces and total, while revealed in significant difference between 2<sup>nd</sup> 6 months and 1<sup>st</sup> year (P> 0.05, mean differences with the same superscript letters) as presented in table (1).

**Table (1): Bone loss difference in different time intervals in group I (Locator):**

Group I		1 <sup>st</sup> 6 months		2 <sup>nd</sup> 6 months		1 <sup>st</sup> year		P-value
		MD	±	M	±	M	±	
		S	D	S	D	S	D	
Surface	Mesial	0.19 <sup>a</sup>	± 0.08	0.52 <sup>b</sup>	± 0.15	0.71 <sup>b</sup>	± 0.15	0.001*
	Distal	0.15 <sup>a</sup>	± 0.03	0.55 <sup>b</sup>	± 0.09	0.70 <sup>b</sup>	± 0.11	0.001*
	Buccal	0.33 <sup>a</sup>	± 0.09	0.68 <sup>b</sup>	± 0.15	1.01 <sup>b</sup>	± 0.03	0.001*
	Lingual	0.21 <sup>a</sup>	± 0.09	0.66 <sup>b</sup>	± 0.17	0.87 <sup>b</sup>	± 0.21	0.001*
	Total	0.24 <sup>a</sup>	± 0.11	0.60 <sup>b</sup>	± 0.16	0.84 <sup>b</sup>	± 0.22	0.001*

MD; Mean difference SD: standard deviation  
 \*Significant difference (P<0.05)>  
 Mean difference with the same superscript letters were statistically insignificant.  
 Mean difference with different superscript letters were statistically significant.

In group II (OLS): Comparison between three intervals was performed by using One Way ANOVA which revealed significant difference between them regarding all surfaces and total (P<0.05), followed by Tukey’s post hoc test for multiple comparisons which revealed significant difference between 1<sup>st</sup> 6

months and other intervals ( $P < 0.05$ , mean difference with different superscript letters) in all surfaces and total, while revealed in significant difference between 2<sup>nd</sup> 6 months and 1<sup>st</sup> year ( $P > 0.05$ , mean differences with the same superscript letters) as presented in table (2)

**Table (2): Bone loss difference in different time intervals in group II (OLS):**

Group II		1 <sup>st</sup> 6 months		2 <sup>nd</sup> 6 months		1 <sup>st</sup> year		P-value
		MD	± SD	MD	± SD	MD	± SD	
Surface	Mesial	0.13 <sup>a</sup>	± 0.06	0.39 <sup>b</sup>	± 0.09	0.52 <sup>b</sup>	± 0.20	0.001
	Distal	0.15 <sup>a</sup>	± 0.03	0.38 <sup>b</sup>	± 0.19	0.53 <sup>b</sup>	± 0.19	0.009
	Buccal	0.28 <sup>a</sup>	± 0.01	0.46 <sup>b</sup>	± 0.10	0.74 <sup>b</sup>	± 0.21	0.001
	Lingual	0.14 <sup>a</sup>	± 0.03	0.31 <sup>b</sup>	± 0.16	0.45 <sup>b</sup>	± 0.17	0.001
	Total	0.17 <sup>a</sup>	± 0.03	0.38 <sup>b</sup>	± 0.14	0.56 <sup>b</sup>	± 0.19	0.001

MD; Mean difference SD: standard deviation \*Significant difference ( $P < 0.05$ )>  
 Mean difference with the same superscript letters were statistically insignificant.  
 Mean difference with different superscript letters were statistically significant.

Comparison between group I & II was performed by using Independent t test which revealed in significant difference regarding baseline – 6 months interval ( $P > 0.05$ ), while revealed significant difference at 2<sup>nd</sup> 6 months & 1<sup>st</sup> year ( $P < 0.05$ ) as presented in figure (4) and table (3).

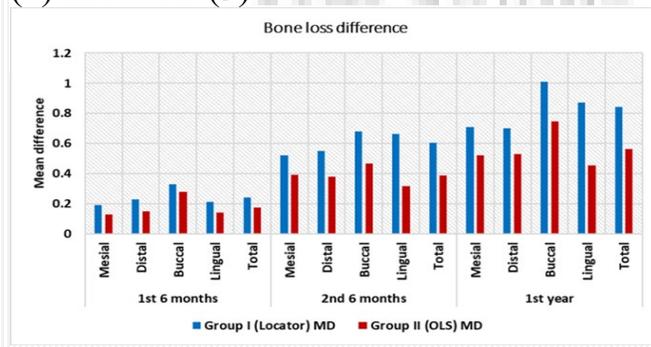


Fig 4: Comparison between group I and group II in alveolar bone loss difference at definite time intervals

**Table (3): Comparison between both groups regarding mean differences of bone loss at all time intervals**

		Group I (Locator)		Group II (OLS)		P-value
		MD	± SD	MD	± SD	
1 <sup>st</sup> 6 months	Mesial	0.19	± 0.08	0.13	± 0.06	0.13
	Distal	0.23	± 0.12	0.15	± 0.03	0.11
	Buccal	0.33	± 0.09	0.28	± 0.01	0.16
	Lingual	0.21	± 0.09	0.14	± 0.03	0.07
	Total	0.24	± 0.11	0.175	± 0.08	0.06
2 <sup>nd</sup> 6 months	Mesial	0.52	± 0.15	0.39	± 0.09	0.02*
	Distal	0.55	± 0.09	0.38	± 0.19	0.05*
	Buccal	0.68	± 0.15	0.465	± 0.10	0.001*
	Lingual	0.663	± 0.17	0.315	± 0.16	0.001*
	Total	0.60	± 0.16	0.3875	± 0.14	0.01*
1 <sup>st</sup> year	Mesial	0.71	± 0.15	0.52	± 0.20	0.05*
	Distal	0.7	± 0.11	0.53	± 0.19	0.05*
	Buccal	1.01	± 0.03	0.745	± 0.21	0.001*
	Lingual	0.87	± 0.21	0.455	± 0.17	0.005*
	Total	0.84	± 0.22	0.5625	± 0.19	0.004*

MD; Mean difference SD: standard deviation \*Significant difference ( $P < 0.05$ )>  
 Mean difference with the same superscript letters were statistically insignificant.  
 Mean difference with different superscript letters were statistically significant

## **Discussion**

Tissue supported overdenture stabilized by two implants is often the restoration of choice due to patient preference, limitation in finance, insufficient available bone to accommodate a greater number of implants or needed improvements in stability, retention, aesthetics and phonetics<sup>(8)</sup>.

This study is considered one of the limited studies on an attachment system with a retentive element made from PEEK. The results of this research demonstrated no significant difference between the OLS attachment with PEEK cap and the locator attachment with nylon cap at the first interval (baseline-6months) as both materials revealed radiographically accepted results towards bone height from all surfaces around the implant.

On the other hand, analysis of the bone height at the second and third intervals show a significant difference in bone height around the implant of the locator attachment with nylon matrix, while the OLS attachment with PEEK matrix recorded lower bone resorption for all surfaces compared to the locator. This might be directly attributed the fact that the attachment type and design have an influence on the amount of stresses transferred to the implants and peri-implant bone<sup>(9)</sup>.

PEEK has shown reasonable durability, flexibility, with high wear resistance and high tensile strength, fatigue and flexural strength. PEEK is used for the manufacture of high-quality, thermo-stable and electrically and thermally

insulating plastic parts. It also possess low specific mass, elasticity similar to the one of bone and this property is the most beneficial one in prosthetic dentistry and almost non-existent material fatigue<sup>(10)</sup>.

In addition, the nature of the OLS attachment achieves longer parallel walls that could provide some frictional forces that help with retention.. Finally, the improved retention behavior of the PEEK attachment in the present investigation might be explained by its design and material. The PEEK matrix provides a slot in the matrix and a hole at the top, this slot and hole expand when the matrix and patrix are connected and could be used Act as a buffer which can minimise the degradation of the matrix surface resulting in less material wear. The OLS attachment has parallel walls and a PEEK retentive matrix with a hole in its center, these results suggest that the locator attachment may be providing a more resilient connection to the implants than the OLS attachment by time, there by resulting in less marginal bone loss<sup>(11)</sup>.

## ***Conclusion***

Within the limitation of current study, it was concluded that using PEEK material as retentive matrix enhance less bone resorption than nylon retentive matrix.

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