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AINSHAMS DENTAL JOURNAL

AIN SHAMS DENTAL JOURNAL
Official Publication of Ain Shams Dental School
March 2020 - Vol. XXIII

Effect of implant supported overdenture with different bar attachment modalities on the implant and overdenture supporting structure

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Purpose: This study examined effect of clip and Retention.sil as bar method of attachment on the implant and overdenture supporting structure.

Material and methods: In a randomized-controlled clinical trial, 14 edentulous male

patients (mean age 53.8 years) were equally assigned to two groups. In each patient, two implants were inserted in the canine area of the mandible using a two-stage surgical protocol. After 3 months, the implants were connected with resilient bars. Mandibular overdentures were retained to the bars with either clips (group I) or Retention.sil (group II). Peri-implant and vertical alveolar bone changes were evaluated radiographically. Evaluations were performed at the time of overdenture insertion (M0), 6 months (M6) and 12 months (M12) after overdenture insertion.

Results: There was a statistically significant difference in vertical alveolar bone changes between bar and Retention.sil. The clip vertical alveolar bone loss where been higher than that of Retention.sil in all situations.

Conclusion: After 12 months of using bar-implant-retained mandibular overdenture, the Retention.sil attachment had significantly decreased vertical bone loss when compared with the clip attachment.

Key words: clip attachment, Retention.sil, implants, mandible, and overdenture. Introduction:

Implant supported overdenture which used to be considered as alternative line of treatment for conventional denture in treatment of completely edentulous mandible, now a day duo to the high success rate of 2-implant retained overdenture, it consider by many author as the standard of care for edentulous patients [(1)].

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One of the main objectives of overdenture treatment is preservation of the residual ridge and reducing the rate of alveolar bone resorption. This could be achieved by controlling the amount of stress transmitted to the implant and overdenture supporting structure [2, 3].

Implant supported overdenture which defined as any removable dental prosthesis that covers and rests on one or more implants has many advantage over the conventional one these advantage are like minimizing anterior bone loss, increasing occlusal efficiency and improving esthetics, stability, retention, support, speech and chewing efficiency of the prosthesis.[4, 5] These are what make many studies show higher satisfaction scores for patients with implant-retained overdentures compared to patients with conventional dentures, while patients treated with conventional dentures became more dissatisfied with time.[6, 7]

The implant is more preferable to be placed in the canine region one in each side duo to greatest height of available bone is located in the anterior region, also away from anatomic limitations especially the inferior alveolar nerve bundle. [8]

Implant may be attached to the denture base by unsplinted attachment like ball attachment or by splinted attachment like bar attachment.

Ball attachment less costly, less technique sensitive, easier to clean and the mucosal hyperplasia is more easily reduced with ball attachment than the bar attachment. [9]

Bar attachment is a bar spanning over an edentulous area joining the abutment. The denture fits over the bar and may connect to it by one or more sleeves. [10]

The bar attachment can classified into two main category bar units and bar joints. Bar units has parallel walls providing rigid fixation with frictional retention and they allow no movement between denture and bar. Bar joints has rounded or semi rounded contour which allow the prosthesis to rotate slightly during mastication which give it stress-braking action, so it minimizes forces on the abutment. Which make it the bar of selection in case of low number of abutments. [11]

The prosthesis may be attached to the bar by many types like clip or resilient soft liner. In this case it takes retention from the bar in addition to support and stability.

Clip attachment is the most commonly used type of attachment with bar. It fabricated from varies type of material metal and nonmetal with different snap-in friction, it permits hinge like movement between prosthesis and bar. [5]

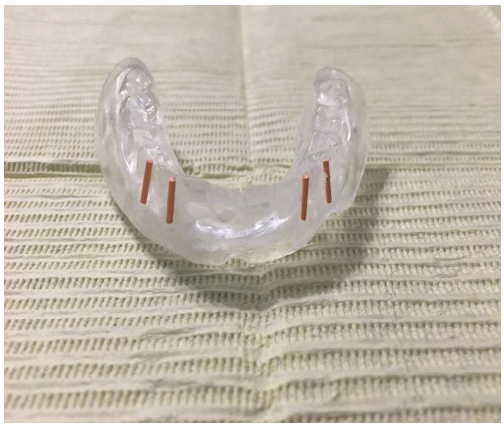
Soft liners are polymers which are soft at mouth temperature because their glass transition temperature is below 37c. This property allows them to close under the bar, which gives the prosthesis retention.

Materials made of acrylic and silicon are mainly used for soft denture lining at present. The silicone soft lining materials are chemically stable and thus the elasticity can be maintained, but as they do not directly adhere to acrylic resin, an adhesive is necessary. The bond strength is not yet sufficient. In addition, as the silicone rubber is porous, food debris, which stagnates inside the pores, enhances the growth of fungi such as Candida albicans, leading to the formation of fungal colonies. On the other hand, acrylic soft lining materials adhere strongly to the acrylic resin denture base, but the added plasticizer will gradually diffuse onto the surface of the resin and will be leached out by the saliva, resulting in a liner that will gradually harden. Also, there is a problem of bacterial contamination which may be due to the roughness of the surface or water sorption of the material. Thus, since soft denture lining materials are likely to be contaminated, the materials are required to be minimally contaminated from the viewpoint of oral hygiene. [12, 13]

The effect of use different type of attachment between prosthesis and bar on the implant and denture bearing area can be assessed by several methods. These methods include clinical assessment, radiographical assessment and or laboratory studies.

Materials and Methods:

Patients' selection



Fourteen completely edentulous patients were selected from the outpatient clinic, Prosthodontic Department. Included patients were required to be Age ranged from 45 – 60 years, exhibiting skeletal Angle's Class-I maxilla-mandibular relationship, with healthy mucosa, sufficient interarch space as well as sufficient bone height in the inter-foraminal region of the mandible and good bone quality. Patients with systemic diseases, TMJ disorders or anticoagulant therapy were excluded. Patients accepted enrollment in this study after being explained about its protocol and objectives and they all signed an informed consent. The patients were informed about the two treatment strategies that could be followed and were asked to participate in the study without prior knowledge of which treatment they were going to receive. Patients were assigned equally to receive either clip (group I) or Retention.sil (group II) using special computer software. Based on this assignment, 7 patients were included in each group. maxillary and mandibular casts were mounted on a mean value articulator to evaluate adequate interarch distance, maxillomandibular relationship, parallelism between the upper and lower ridges, and the presence of at least 15 mm vertical space for the lower denture. A radiographic stent were fabricated on the waxed up lower dentures

After duplication into transparent heat cured acrylic resin to be used as for a cone beam computed tomography after fixation of four gutta-percha markers labially between lower lateral incisors and canines, and lower canines and first premolars in both sides (Fig1).

Fig 1: radiographic stent

Cast with spacer duplicated in stone, the overdenture constructed over the stone cast following the conventional technique with its Posterior teeth were set with their central grooves centralized over the crest of the ridge and the height of the occlusal plane was set from the tip of the canine to the bottom of the upper third of the retromolar pad.

The strain gauges[**]used in this study were supplied with fully encapsulated grid and attached wires. The gauge length was 2 mm, the gauge resistance was 120.4 ±0.4 ohm and the gauge factor was 2.09 ±1.0 %. The wire used for the strain gauges was insulated by a

* *Kyowa electronic instrument co, LTD Tokyo. Japan

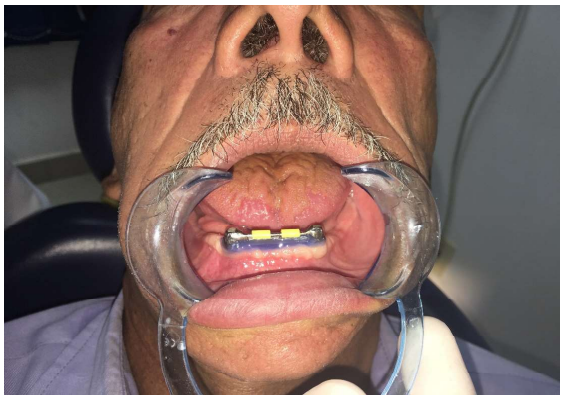
packing material.

A flat plane parallel to the long axis of the implant was created in the left implant labial and distal surface to receive the strain gauge. The two strain gauges were installed and fixed in position using an adhesive*** recommended by the manufacturer. Third strain gauge was installed vertically on the residual ridge at the second molar area.

In order to Simulation of the oral mucosal layer the denture bearing area was painted by rubber adhesive*****. Overdenture tissue side was painted by separating medium. Medium body rubber base******* was placed in the overdenture, then it was repositioned and pressed in its place tell completely seating, then the two acrylic tissue stoppers in the fitting surface of the denture were removed and refilled by medium body rubber base and the denture was refitted to the acrylic cast.

Space was created in the fitting surface of the lower overdentures opposite to the bar, and two vent holes were opened in the lingual flange of the denture opposite to it. A clip********* was placed in its position on the bar. Undercuts beneath the bar were blocked out with sticky wax. Auto-polymerizing acrylic resin was applied in the space created in the fitting surface of the denture and the overdenture was placed and seated properly on the model.

Load was applied using the universal-testing machine in-between second premolar and first molar region bilaterally and unilaterally from zero up to 100N.



For retention test the acrylic model

Fig 16: block out for the undercut

with the overdenture were attached to the lower part of the universal testing machine. A special device attached to the upper part of the universal testing machine started to pull the lower denture throw a bar fixed in-between the first and second premolars bilaterally.

The universal testing machine started to pull the overdenture with force zero. When there is a sudden drop in the force needed to pull the overdenture, the testing machine stopped. The maximum force needed was recorded (Fig2).

* ** Strain gauge cement, Kyowa electronic instrument co, LTD Tokyo, Japan.

** *** Zetaplus adhesive, Zhermack., Italy.

*** **** Speedex,medium, colton A. G, Alsatten, Switzerland

**** ***** OT Retentive clip attachments, CSA, RHEIN, Italy

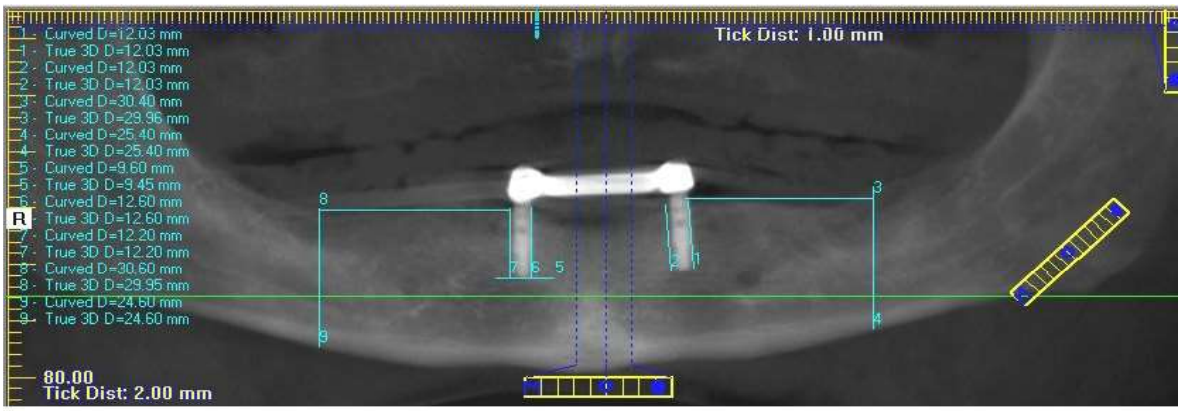


Fig 3: measuring of bone height

Fig 2: retention test

For design two a space was created in the fitting surface of the lower overdentures opposite to the bar, and two vent holes were opened in the lingual flange of the denture opposite to it.

A piece of tin foil adapted over the bar and extended on buccal and lingual slops was secured in its place to prevent the soft liner to meet each other under the bar (Fig 3).

Self-cure soft liner material was applied in the space created in the fitting surface of the denture and the overdenture was placed on the model.

The same steps for loading and retention of design one was followed with this design. Enough time was allowed between each two successive readings (not less than 15 minutes) to allow the strain gauges to be in zero balance before making the next reading.

Data were collected, tabulated and statistically analyzed by t-test to compare between the two designs.

Results:

		Clip Bar	Resilient Material	Sig.
bilateral	labial	**-214.7±12.12**	**157.3±14.1**	**< 0.01**
	distal	**-137±7.64**	**-74.2±5.11**	
	ridge	**-32.89±3.06**	**-36.48±7.2**	.170
functional	**labial**	**-260.75±8.86**	**211.7±11**	**< 0.01**
	distal	**-95.09±3.99**	-134.6±8.6	
	ridge	-105.9±3.99	-80.14±5.6	
Non- functional	labial	-233.8±10.68	-100.5±4.4	< 0.01
	distal	-11.36±2.48	23.92±2.56	
	ridge	-12.56±3.56	3.51±1.46	
dislodging	labial	-91.19±5.63	8.37±1.79	< 0.01
	distal	19.56±5.04	6.54±0.29	
	ridge	28.58±5.64	10.89±1.55	

Comparison between recorded microstrains measured beside implant in bilateral loading in two studied designs, the mean recorded microstrains with clip attached bar design showed statistically significant higher value than that with resilient material. While in ridge the difference was insignificant.

Comparison between recorded microstrains measured beside implant in unilateral loading at functional side at labial in two studied designs, the mean recorded microstrain with clip attached bar design showed statistically significant higher value than that with resilient material, as well as on ridge. While at distal the mean recorded microstrain with resilient material design showed statistically significant higher value than that with clip attached bar.

Comparison between recorded microstrains measured beside implant in unilateral loading at nonfunctional side at labial, distal and on ridge in two studied designs, the mean recorded microstrain with clip attached bar design showed statistically significant higher value than that with resilient material

Comparison between recorded microstrains measured beside implant and on ridge during overdenture removal in two studied designs, the mean recorded microstrains with clip attached bar design showed statistically significant higher value than that with resilient material.

Discussion:

This stress analysis study was conducted to assess and compare the stress induced by different bar attachment modalities in implant overdenture.

Since stresses transmitted to the implant supporting structure are a multi–factorial affected by prosthesis height, prosthesis design, and abutment tilt. For standardization as much as possible and for more reliable results, one model with the same implants was used for this study. Also the same prosthesis was used with changing the bar fitting surface for the same reason [DM4, 10].

A layer of wax 2 mm in thickness was applied on the surface of the acrylic cast before duplicate into a stone cast for denture fabrication, in order to provide a homogeneous space between the denture and the acrylic cast. Two squares 2 mm in length were cut in the wax in 2nd molar region bilaterally to provide two stops to prevent over seating of the denture posteriorly, while the bar prevents that anteriorly.

Self-cured plasticized acrylic resin soft liners was used in this study duo to its availability and easy to manipulation, while its main disadvantage which is leach out of plasticizer and loss of elasticity is not applicable her duo to it is in-vitro study and no present of water.

Strain gauge technology was used in this study; this technology was used as it is sensitive, stable, accurate and reproducible on the selected sites and can be applied nearly in every situation where strains are to be evaluated with few problems [16].

The results obtained from this study showed that in all loading situations whether unilateral or bilateral, the clip attachment design develop more stresses on the abutment than do resilient material, this could be duo the more rigid connection present between bar and clip. This could be conclude what had been found by clinical study that the resilient liner attachment had significantly decreased peri-implant plaque score, gingival score, probing depth, vertical and horizontal bone loss when compared with the clip attachment [17] .

Compression force present on the labial aspect of abutment during prosthesis dislodging could be duo to rotational movement of the prosthesis about the fulcrum which was the bar in this situation which make labial flange exert force on the abutment, while this force was not present in soft liner case duo to the cushion effect of soft liner.

According to mode of loading it had been found that more stresses developed by unilateral loading in functional side than stresses developed by bilateral

loading, this unilateral vertical loading may causing excessive torquing forces on the overdenture supporting structures duo to rotation of the prosthesis around a fulcrum axis formed by the crest of the ridge and or the bar.

Conclusion:

Within the limitations of this study, it could be concluded that, From the results of this study it could be concluded that the clip attachment gives overdenture more retention, but it transmitted more stresses to the implant than soft liner do.

Unilateral loading induced more stresses to the implants than bilateral posterior loading.

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