

THE EFFECT OF FOUR IMPLANTS VERSUS TWO IMPLANTS CONNECTED WITH BAR RETAINED MANDIBULAR OVERDENTURE ON BITING FORCE

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ABSTRACT

Background: Implant retained overdenture is a first treatment choice with high rate of success to improve oral function, esthetics, enhance masticatory performance and patient's satisfaction. Bite force is one indicator of the functional state of the masticatory system that results from action of jaw elevator muscles modified by Cranio-mandibular biomechanics.

Objective: The purpose of the present study was to evaluate the effect of increase implant number from two to four implants on maximum bite force.

Material and methods: sixteen patients with upper and lower edentulous ridge participated in this study. Patients were rehabilitated with two or four implant retained overdentures. Patients were divided according to the available bone in to two groups. **Group (A):** patients had received two implants retained overdentures. **Group (B):** patients had received four implants retained overdentures. Implants were inserted in mandibular canine area bilaterally in group (A) and in mandibular canine and first premolar area bilaterally in group (B). After three months, bar was attached to the implants. The lower overdenture was picked up intraoral and occlusal adjustment was done by using Tscan device. The biting force was evaluated by using Loadstar sensor device which was placed in the premolar molar area in right and left side. Patients were instructed to bite on the top of the sensor and the biting force values were displayed on a computer connected to the device.

Results: the biting force of both groups increased gradually in the follow up period and group (B) had shown statistically significant higher bite force value than group (A).

Conclusion: The maximum biting force of patients with two and four implants retained overdentures had been increased and there were a significant difference as four implants was higher than two implants.

KEY WORDS: implant retained overdenture; biting force; distribution of occlusal force.

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INTRODUCTION

Dentures wearers mostly reported problems with mastication, mainly due to complain of retention and stability specially in the mandibular prosthesis. The comparison of masticatory function between dentures wearers and natural healthy dentition is very poor. Oral function significantly improves after rehabilitation with implant retained mandibular overdenture. ^(1,2)

Various treatment modalities with implant retained prosthesis have been described for mandibular edentulous ridges. Two to four dental implants placed in interforaminal area has shown high success rate. ⁽³⁾

When more than two implants are in the anterior mandible a great AP spread of the implants will result which increase biomechanical advantage to reduce stress on the implants and better lateral stability of implant bar and overdenture system. ⁽⁴⁾

There were many advantages to splinting implants. Splinted implants increase functional surface area of support, increase the anteroposterior distance (AP spread) to resist lateral loads, distribute force over a large area, decrease the risk of abutment screw loosening, decrease the risk for marginal bone loss and decrease the risk of implant component fracture. ^(5,6)

T-Scan is a computerized occlusal force analysis device which is an essential part of clinical functional analysis in prosthetic insertions. The T-Scan computerized system can accurately identify prematurity, high spots, the point of excessive force and non-uniform force distribution it also determine dis occlusion time precisely. ⁽⁷⁾

Bite force measurement can be used as a parameter indicating the functional condition of masticatory system. ⁽⁸⁾

Aim of the study

The aim of the present study was compare the effect of different implant number (two and four) on maximum bite force

MATERIALS AND METHODS

Sixteen male patients with upper and lower edentulous ridges with age ranged between 55-65 years were selected to participate in the study from the clinic of Prosthodontics department, Faculty of Dentistry, Ain Shams University.

Inclusion criteria were: male completely edentulous patients, good oral hygiene and firm healthy mucosa cover the residual alveolar ridge, skeletal class I maxillomandibular relationship, patients whose ages range 55-65 years, adequate interarch space, adequate bone quality and quantity in interforaminal area and free from any systemic diseases .Exclusion criteria were: patients suffering from neuromuscular disorder, patients suffering from tempromandibular disorder, parafunctional habits and smokers.

Preliminary upper and lower impressions were made to obtain casts, then a tentative jaw relation was done and mounting for the diagnostic casts on a mean value articulator to ensure the presence of at least 12 mm interarch space to allow the bar placement.

Each patient performed pre-operative cone beam computed tomography to evaluate the bone quality and quantity at the interforaminal area.

Complete dentures were constructed by conventional manner for all patients and follow up was done for two weeks before the surgery.

Virtual implant planning:

A. Dual scan protocol: Virtual planning started with dual scan protocol by performing modification to the mandibular denture into a radiographic stent by addition several small round

markers of composite on the labial and buccal flanges of the denture. The first scan was done for the mandibular denture on the cast and the second one was done while the mandibular denture in the patient's mouth and biting in centric occlusion.

B. Patient grouping: According to available bone the virtual treatment plane was carried out and determine who was received two implants (group A) and who was received four implants (group B).

Stereo lithographic surgical guide construction

The mandibular stereo lithographic surgical guide was constructed with two or four metallic sleeves to guide implant placement in the virtually designed place with the precise depth, angulations, mesiodistal, and buccolingual positions as planned during computer simulation. In addition, two or three windows were constructed labially for fixation screws at a sufficient distance from the proposed implants' drilling places.

Surgical protocol

- Prophylactic antibiotics were prescribed for patients 24 hours before surgery. The surgery was carried out under local anesthesia.
- A silicon occlusal index (Zeta Plus, putty. C-silicone impression material-zhermack company-Italy) was used to support the surgical guide in the patient's mouth, then insert the anchor pins which used to secure to the stent to mandibular bone.
- The preparation of osteotomy was done by using the universal surgical kit supplied by the manufacture of the guide (NaviGuide). The sequential drilling was done for each implant through the surgical guide. Sterile copious saline irrigation was used throughout the drilling procedure.

The anchorage pins were unscrewed, and the surgical guide was removed from the patient's mouth.

- Implant with diameter 3.5 mm and length 11.5 mm, was inserted into the prepared osteotomy.
- After implant installation, the covering screws were inserted and screwed directly into the implants.
- After surgery, patients were instructed to continue the antibiotic for five days, use oral non-steroidal anti-inflammatory to reduce pain and rinse with Chlorohexidine mouthwash two times per day for plaque control.

Healing period

After 3 months healing.

Prosthetic procedures

Second stage surgery: The implants were exposed by made separate small crestal incisions corresponding to the implants. The cover screws were removed and the healing abutments placed over the implants to allow the soft tissue to healing.fig (1)

Bar construction

Impression procedure:

- One week later an open tray impression technique was done by using long impression copings after removing the healing abutments.



Fig (1): Healing abutments

- Impression copings were splinted using orthodontic short power chain and autoplomerized resin material to form a solid mass, keeping a free space beneath it to allow penetration of the impression material.
- The special tray was filled with (vinyl polysiloxane regular body) impression material, and additional material was injected around the copings and the rigid connection, then the tray was inserted in the patient's mouth.
- After the setting of the impression material, the impression copings were unscrewed so it removed from the mouth with the impression as a one unit then the implant analogues were screwed to the impression copings. The impression was poured in a hard dental stone.

A verification jig was made to insure accuracy of the impression and check it in the patient mouth by periapical radiograph.

UCLA abutments ** (University of California at Los Angeles Abutment) were attached to the implant analogues at cast and connected with a bar **** with 5 mm height, 4 mm width and 1 to 2 mm space below the bar to allow cleaning. The top surface is round which. After investing, the plastic bar and the plastic part of the abutments were burned -out of the wax pattern and molten alloy was casted into the investment mold creating a framework pattern which provides cast interface that match directly with the implants. The cast framework was tried on the cast and inside the patient's mouth to ensure passive fit clinically by probe and one screw test (Sheffield test) by screwing the abutment on one side and checking the fit on the other terminal abutments and radiographically by periapical radiograph. The space between the bar and the gingiva was evaluated

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Fig (2): Checking of the bar in patient mouth.

to ensure the presence of sufficient space for oral hygiene.

A new mandibular denture was constructed as conventional by taking secondary impression in acrylic resin special tray with rubber base impression material***, followed by jaw relation record, try-in, final denture insertion Block the undercuts below the bar with elastomeric impression material was important before the denture pickup. Two plastic clip attachments were secured over the bar and the Plastic clip attachment**** secured over the bar Pickup of the clip was made directly intraoral. A sufficient relief was made in the fitting surface of the prostheses corresponding to the clip and two small holes were made at the lingual flange to allow for escaping of excess material then the fitting surface at this area was treated with acrylic monomer. Auto polymerizing acrylic resin***** was mixed and applied in this area.

The prosthesis was inserted in the patient's mouth and the patient was guided to close in centric occlusion. After setting of the pickup material, the prostheses was removed from the patient's mouth then the excess material was removed.

*** Thixoflex, Oranwash L, C-silicone impression material, Zhermack. Italy.

**** Rhein83 Italy

*****Hard Denture Liner, Promedica GMBH, Germany

Occlusal adjustment

The distribution of occlusal force was done by using T-Scan III device which consists of a sensor registering occlusal contacts, a data transferring module linked to a computer, a software program to transfer data to the computer and show it on the screen. The recording procedure is performed according to the manufacturer’s instructions of using the device to register occlusal contacts. The patient is seated on the dental chair in upright position. The width of maxillary central incisor was measured by periodontal probe to determine the proper size of the sensor provided enough width to cover the molar when the patient close, The T scan handle was connected to the computer by USB cable and the sensor was inserted in the patient mouth touch the central incisor at the mid line. T scan device has range of colors to differentiate the forces on the teeth. The patient was asked to sit in upright position and bite and clench on the sensor while the teeth contact was observed on the screen for two second and then open his mouth. The same procedure was done at protrusive and lateral movement then repeated three times for taking the average. A 3 D movie window, graph window and graph zoom window were also automatically opened for the current movie. The

graph and graph zoom windows contain color coded traces representing the forces applied on each tooth, the magnitude of force applied, the distribution of the forces along the arch and teeth under heavy contact and premature contact inside each of the colored boxes in the 2 D movie window.

According to the data displayed on 3D graph, teeth with premature contact were reduced and the process was repeated until nearly the contact between posterior teeth is equal in distribution and intensity in both arches.

Biting force measurement:

The biting force measured by The Load star sensor** in Newton the sensor was mounted horizontally to allow vertical application of force. The direction of force was perpendicular to the top surface of the sensor as any angular force vector may lead to inaccuracy. The patient was seated in an upright position. The load sensor was wrapped and placed at the premolar-molar area in right side then in left side. The patient was instructed to bite maximally; whereby the direction of applied force was vertical. An average of ten reading was taken immediately after insertion and occlusal adjustment by T scan, one month and three month late

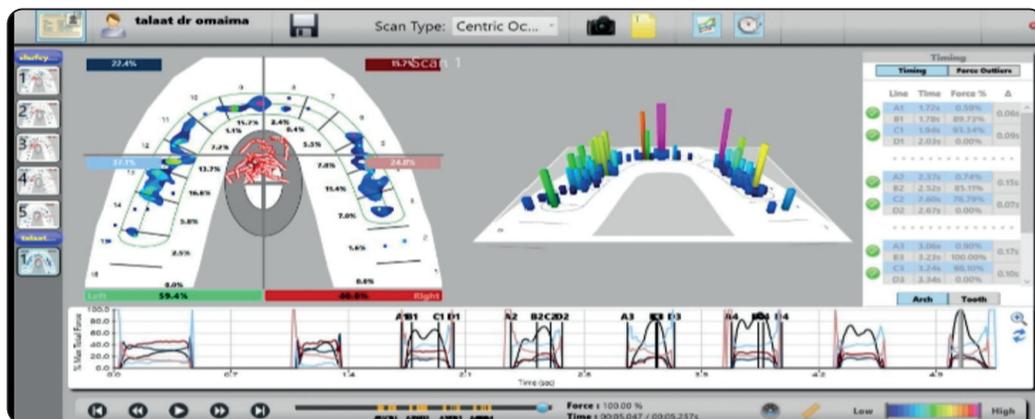


Fig (3): T scan III software system interface.



Fig (4): The I-load star sensor device.

RESULTS

Comparison between Group A & B was performed by using Independent t-test which revealed that group A was significantly lower than group B at after 1 month – after 3 months interval regarding right, left & overall. Regarding Baseline - After 3 months interval, group B was significantly higher than group A regarding right, left & overall. As presented in table (1) and figure (5).

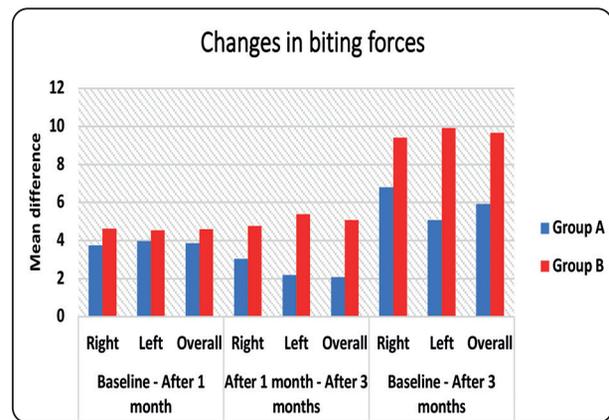


Fig (5): Comparison between group A (2 implants) and group B (4 implants) regarding biting forces.

TABLE (1): Comparison between group A (2 implants) and group B (4 implants) regarding biting forces difference between baseline & after 1 month, after 1 month & after 3 months and baseline & after 3 months in right side, left side & overall

Interval	Side	Group A		Group B		P value (Independed T test)
		MD	SD	MD	SD	
Baseline - After 1 month	Right	3.76	1.6	4.64	1.56	0.0003*
	Left	3.97	1.65	4.55	1.1	<0.0001*
	Overall	3.865	1.625	4.595	1.33	<0.0001*
After 1 month - After 3 months	Right	3.04	0.6	4.77	1.21	<0.0001*
	Left	2.19	2.23	5.38	0.76	<0.0001*
	Overall	2.075	1.415	5.075	0.985	<0.0001*
Baseline - After 3 months	Right	6.8	1	9.41	0.35	0.0025*
	Left	5.08	-0.58	9.93	0.34	0.04*
	Overall	5.94	0.21	9.67	0.345	0.61Ns

MD: mean difference SD: standard deviation

* Significant difference as P value ≤ 0.05

Ns= nonsignificant difference as P value > 0.05

DISCUSSION

The present study was interested in use two and four titanium dental implants in the anterior mandible to benefit from the advantages of implant supported overdentures over conventional complete^(9,10)

The age of the selected patient was 55 to 65 years. Very old patients were excluded to avoid skeletal muscle atrophy due to senility which may affect muscle activity, temporomandibular joint and healing process of implant placement site.⁽¹¹⁾

All patients in this study were males as the male's bite force is higher than females. This difference in biting force due to gender variable may be attributed to the strong musculature of the males caused by anatomic difference.⁽¹²⁾

The guide was stabilized and fixed in its place with anchor pins to prevent micro movement that can affect the implant placement position.^(13,14)

Bar attachment was the choice in this study because the implants splinted with bar allow better distribution of the force and less prosthetic maintenance in comparison to non-splinted implants.⁽¹⁵⁾

The results of the present study revealed that; there was a gradual increase in the maximum biting force in patients rehabilitated by implant overdentures in the two studied groups throughout study period. This finding may be attributed to many reasons:

The gradual increase in the maximum biting force may be attributed to the neuromuscular co-ordination and adaptability of the patient to the prostheses upon time.

As it was reported that implant supported prostheses may restore the oral function successfully, both subjective and objective indicators of chewing ability score better compared to conventional complete dentures.⁽²⁾

The result of implants treatment in improving the stability and retention lead to decrease patient's

difficulties and enhance them to exert higher biting force.^(16,17)

Longitudinal study compared the maximum biting forces and the corresponding muscle activity levels two months after placement of mandibular implants to stabilize the dentures. This study reported significant increases from 41% to 58% in maximum bilateral molar bite forces after supporting the dentures with the implants. This study also reported increases in the amount of muscular effort from 24% to 35% at the same two month period.⁽¹⁸⁾

The higher security of implant retained overdentures had provided the patients more confidence and improving their self-esteem leading to higher maximum biting force values. Moreover, it is documented that the presence of great number of occlusal contacts which lead to a stable reference for the action of muscles of mastication, both static (biting, swallowing) and dynamic (chewing) activities became more high.⁽¹⁹⁾

Those results are directly related to researches that proved improvement of the masticatory efficiency and maximum biting force in patients wearing implant overdentures. As, recent histological investigations found some kind of nervous regeneration in correspondence of the bone surrounding Osseo integrated implants Those Osseo receptors may improve the patient's biting force and masticatory efficiency⁽²⁰⁾.

Moreover, the presence of implant- attachment system had improved the retention and stability of implant overdentures.⁽¹⁹⁾

The four implant overdentures had recorded higher maximum biting force values than two implant overdentures due to the presence of more implants and bar attachments so increase anteroposterior spread, improving the support and retention of overdentures. Consequently, the oral functions as the biting force had been improved.

CONCLUSION

Within the limitations of this study, it could be concluded that the maximum biting force of patients with two and four implants attached with bar and clips retained overdentures had been increased and there were a significant difference as four implants was higher than two implants.

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