International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 197-202 www.ijdmsrjournal.com ISSN: 2582-6018

Stress free implant bar for 4-implant supportedMandibular Over-dentures.AClinical EvaluationOfcurved VS quadrilateral implant distribution

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Submitted: 15-03-2024 Accepted: 27-03-2024

ABSTRACT:
Purpose: This clinical study aimed to evaluate maximum bite force(MBF) of different distributions of four implants supported mandibular overdentures using Stress free implant bar (SFI-Bar® attachments).
Materials and Methods:Nine completely edentulous patientswith insufficient retention and stability of their conventional mandibular denture were eligible for this study. All patients received new maxillary and mandibular dentures. The patients were randomly divided into three groups. The first group (CD): patient receive new maxillary and mandibular conventional complete denture. The second group (G1): where the four implants were distributed in interforaminal distance, 2-Implant were inserted in canine region and 2-implant 8mm posterior to canine implants. The third Group (G2): where the 4-implants were distributed in quadrilateral distribution, 2-Implant in canine region and 2-Implant were inserted 26mm posterior to canine implant. ImmediateloadSFI-bar®* (Cendres+Me′taux,Biel/Bienne,Switzerland) attachments were used to assist the mandibular overdenture. MBF outcome was evaluated using digital bite force transducer. The measurements were evaluated at time of mandibular overdenture/denture insertion(T0), three month (T3), and six month (T6) after mandibular overdenture/denture insertion.Results: Bite force significantly increased with time for all groups (<.001) at all times of measurements. Quadrilateral group was associated with the highest maximum bite forces followed by interforaminal and CD showed the lowest bite force.Conclusion:Within the limitations of this short-term investigation, both distrubution of 4-implant supported overdentures with SFI-Bar®, used for rehabilitation of completely edentulous patients improve MBF compared to CD, however, quadilateral distubution reported increase the MBF, followed by interforaminal destrubution.
KEYWORDS:Mandibular overdenture, interforaminal, quadrilateral, maximum bite force, implants.

I. INTRODUCTION

Edentulous patients often experience problems with their mandibular complete dentures.Tosolve this problem, two to four implants can be placed into the mandibular to support overdenture.[1] Bar attachment system has the greatest retention.[2–4]On the other hand, increased chair time and high cost of fabrication are problems in that system. In addition, for appropriate adaptation of the bar, soldering or laser welding procedure is often necessary to compensate the dimensional change due to the errors arising from some procedures such as impression making and laboratory process. SFI-Bar® can overcome these weak points. This system is a "chairside" system, as all preparations can be inserted into the patient's mouth after the implants have been put into place.

Implant-supported overdenture has a minimum of two implants inserted in the region of the mandibular canines.[5] Increasing the number of implants will shift the support from mucosal surface to implants.[6] This type of treatment helps reducing the resorption rate of ridges and increasing denture retention and stability, so that patients with overdentures reportgreater satisfaction than with conventional complete dentures.[7–11]

There are many clinical reports that have evaluate patient satisfuction of 2-implant retained overdenture with SFI-Bar®.[12]But there have been a few data of maximum bite force evaluation of SFI-Bar® using different 4-implant distribution.So**, the aim of this study was to evaluate maximum bite force on different implant distribution curved**

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 197-202 www.ijdmsrjournal.com ISSN: 2582-6018

vercess quadrilateral distribution using SFI-Bar®

II. MATERIALS AND METHODS

Nine patients of age 45-60 years were selected from the out patient clinic, Prosthodontic Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt. All patients had maxillary and mandibular edentulous arches. The inclusion criteria for patient enrollment were sanitary mucosa; mandibular edentulism for at least 6 months. Type II or III interforaminal edentulous ridge in according to the classification proposed by Lekholm and Zarb.[13] The patients had good general condition, and class III to V resorption of the mandible according to Cawood and Howell.[14] The exclusion criteria included the following: Systemic diseases contraindicating implant surgery in the mandibular arch as diabetes or osteoporosis, metabolic bone disease, and previous tumors or irradiation at the head and neck region, parafunctional habits as bruxism, or smoking habits. The study protocol was approved from ethical committee unit of Faculty of Dentistry, Mansoura University with No (A09011122). The objectives were explained to all participants before obtaining signed informed consent.

Figure 1: SFI-bar® in the patient mouth.

Figure 2: pickup of the titanium housing to fitting surface of the denture

III. SURGICAL AND PROSTHETIC PROCEDURES:

For each participant, a dual scan process was performed using CBCT* (i-CAT, Pennsylvania, USA) one scan for the denture alone and the other scan while the patients wearing the dentures in occlusion. Implant positions were planned at canines for both group. In G1 (Intra-foraminal): posterior implants are 8 mm posterior to the canine implants [minimum allowed inter-implant distance for SFI-bars®*](Cendres+Me′taux, Biel/Bienne, Switzerland). In G2 (Quadrilateral): posterior implants are 26 mm posterior to the canine implants [Maximum allowed inter-implant distance for SFI-bars®]. Using the software* (OnDemand3D). The plan was used to construct the surgical template.

Four implants* (Neoss Proactive dental implant ®), were in serted using the surgical guide and the universal surgical kit. The insertion of implants was done by the same oral and maxillofacial surgeon at a minimum torque of 40 Ncm to give the high initial stability required for immediate loading. All implants were immediately loaded by the mandibular dentures after implant placement.

For the both groups, the SFI-Bar® implant adapters were tightened to the implants, and tube bars were screwed to the implant adapter using a screw driver. The ball joints were aligned to the implants, and fixation screws were slightly loosened to align the pins. The tube bar with the tube bar gauge was slided onto the pin of the ball joint until the convex part of the tube bar gauge could be fitted onto the implant adapter, and the retaining screws were retightened. The tube bar was sectioned with a cutting disk. The shortened tube bar was slided onto the two ball joints and retightened tension-free. The procedure was repeated for the other two segments of the bar.

The metal housings with retaining plastic clips were positioned on bar segments. The denture relieved over the housing. The space under the bar was blocked out with wax, and the metal housings with retaining plastic clips were picked up to the denture using using self-cure acrylic resin, patient was guided to occlude into centric occlusion untill curing of resin (functional pickup process). Excess acrylic material was removed, and the denture was finished and polished. The denture was checked for proper occlusion and retention, and then delivered to the patient.

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The patients were prescribed a soft diet and informed to wash with 0.12% chlorhexidine mouthwash three times per day for 14 days. The patient had restricted follow up twice at first month and once in the second, third month

IV. STATISTICAL ANALYSIS

The data of bite forces met the normal distribution and were parametric as indicated by Shapiro-wilk test. Comparison of bite force between different observations (T0, T3 and T6), and groups was performed using repeated measures ANOVA followed by Bonferroni tests for multiple comparisons. The data were analyzed using SPSS® software version 25 (SPSS Inc., Chicago, IL, USA).

Evaluation of Maximum Bite Force (MBF):

For both groups of patients, the evaluation of maximum biting force was performed using digital bite force transducer*(loadstar sensor ®) for new conventional denture (CD), 4-Implant supported overdenture with interforaminal distribution (G1), and quadilateral distribution (G2).

The bite force transducer was placed on the first molar zone, and the patient was requested to bite as powerfully as possible on the device for 5 seconds in an upright position. Measurements were done for both right and left sides. Each measurement area is chosen to be the MBF measurement site where 80% of total bite force is exerted. The measurements of MBF were performed immediately after insertion (T0), after three months (T3), and after six months(T6) from mandibular denture /overdenture insertion.

V. RESULT

A. Comparison of maximum bite force between observations

There was a significant difference in bite force between observation times (Table1). Bite force tend to significantly increase with time for all groups and, there was a significant difference between each 2 observation times.

B. Comparison of maximum bite force between groups

There was a significant difference in bite force between groups (Table1). Quadrilateral recorded the highest bite force followed by interforaminal, and CD showed the lowest bite force.

	T0		T3		T6		Repeated ANOVA
	X	*SD*	*X*	*SD*	*X*	*SD*	
CD	42.77	2.52	61.05	2.52	68.30	2.65	<.001*
INTERFORAMINAL	60.72	2.00	78.42	2.08	91.63	3.21	<.001*
QUADRILATERAL	70.69	1.53	87.29	2.65	103.32	2.52	<.001*
Repeated ANOVA	<.001*		<.001*		<.001*		

Table 1: Comparison of maximum bite force between observations and between groups.

VI. DISCUSSION:

The purpose of this study was to determine the MBF in different distrubutions of 4-Implant supported overdenture using SFI-Bar®.

The present study showed that, MBF was higher in patients with both distribution of implant supported overdenture with SFI-Bar®, compared to conventional CD. This result may be attributed to the retention of denture with implant and SFI-Bar®, which decrease pain and permit the patient to exert more MBF.[15]

On other hand, CD observed the least MBF. That may be attributed to the pain that may be caused by denture displacement during biting

and the fear of the patients from denture fracture if they exert increased MBF.[16] Moreover, denture instability alters the electrical activity of the temporal muscles and may cause muscle fatigue, which may be responsible for reduced MBF.[17] The reduced BF with CD also may be attributed to the reduced muscle activity as denture wearers have weaker jaw muscles resulting from chronic under use of the jaw muscles when dentures are unstable.[18]

This result may agree with several previous studies, the findings of Bakke et al,[19] Fontijn-Tekamp et al,[20] that studied 3 groups of patients (overdenture, conventional complete dentures, and natural dentition, was that MBF in patients with implant-supported overdenture is significantly higher than that in patients with conventional complete dentures, even higher than that in patients with overdentures on natural roots. Moreover, another study's[21–24] in agreement withstudyfound that; dental implants increase MBF in edentulous patients, independent of the number of implants.

Also, Baca and colleagues,[25] who reported that overdentures assisted by four implants showed higher MBF values than patients with CD and patients with two-implant overdentures, and this improvement remained established after 10 years.[26]

In this context, van der Bilt et al.[27]conducted a study to evaluate biting force of complete denture and implant-supported mandibular overdenture, which has showed a statistically significant increased biting force from 116 N to 200 N for complete denture and overdenture, respectively.

In this study the MBF observed to significantly increased with time for all group. This may be inferred to the increase in patient muscle accommodation by time, then the biting force can increase.[28]As proved with El-Shaheed et al.[29] study stated that restoring the edentulous mandible with CAD-CAM constructed implant-assisted overdentures increases tissue surface adaption and MBF when compared to conventional CD.

The results of this study revealed significant increase of MBF in G2 compared to G1. This may be attributed to complete implant support in G2, rather than implant tissue support in G1, the presence of mechanoreceptors in the mucosa may increase peripheral input, which may reduce muscle force to avoid pain and discomfort during biting. Conversely, the total implant support of overdentures in G2 reduces peripheral input due to the reduction of mechanoreceptors around implants and consequently increases muscle forces.[16,30]

This results may be consistent with this finding, a previous study,[31] revealed that found quadrilateral distribution of four implants used to retain mandibular denture is more advantageous than linear distribution, due tofavourable support achieved with the quadrilateral design,[32,33] which is similar to a four-legged chair.[34]Also, in line with our results, Caruso and Cattaneo[33] stated that mandibular overdentures supported by four implants placed in the positions of the canines and molars improve and simplify anchorage systems based on conical copings.Therefore, better option is to insert posterior implants at molar areas whenever posterior bone height permits, and before advanced bone resorption occurs.

VII. CONCLUSION

Within the limitations of this study, it is concluded that:

- Quadrilateral and interforaminal distribution of implant supported overdenture using SFI-Bar®, increase MBF than conventional denture.
- Quadilateral implant distrbution improve MBF than interforaminal for implant supported overdenture.

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