EGYPTIAN DENTAL JOURNAL

VOL. 63, 1819:1826, APRIL, 2017

I.S.S.N 0070-9484

FIXED PROSTHODONTICS, DENTAL MATERIALS, CONSERVATIVE DENTISTRY AND ENDODONTICS

www.eda-egypt.org • Codex : 116/1704

EFFECT OF DIFFERENT TYPES OF ATTACHMENTS ON PATIENTS MUSCULAR ACTIVITY

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ABSTRACT

Objectives: The aim of this study is to compare the electromyographic muscle activity of both the buccinator and temporalis muscles in patients wearing implant supported over-dentures using different types of attachments namely: A) Bar attachments. B) Magnet attachments. C) locator attachements.

Materials and methods: twenty one patients were selected having completely edentulous upper and lower arches, divided into three groups, **group A** having implant-supported mandibular overdenture with bar attachment, **group B** having implant-supported mandibular overdenture with magnetic attachment and **group C** having implants supported mandibular over denture with locator attachment. In selected groups, the implants were placed in the canine region, muscular evaluation was performed in each phase during the study by using a digital electromyogram (EMG)* Muscular activity, represented by the root mean square value (RMS), was evaluated.

Results: data obtained from the present study showed that there was no significant difference between attachments according to muscular activity measured.

Within the limitations of this study: it was concluded that: I. In elderly patients, the treatment with 2 inter-foramina implants provides evidence of neuromuscular adaptation towards values of healthy dentate, thus the known benefits of implant placement such as tissue perseverance and improved function are complemented by improved neuromuscular adaptation. II. There was no significant difference between bar, magnet and locator attachments regarding the muscular activities measured.

INTRODUCTION

The most important objectives of complete dentures are restoration of masticatory function, facial appearance, speech, and the Maintenance of the patient's health. Where food mastication assist the completely edentulous patients in obtaining adequate nutrition.[1] It has been reported that the use of implants retained mandibular over-dentures resulted in a significantly better chewing experience, masticatory performance, less complaints and higher satisfaction when compared with conventional complete denture treatment.[2-3]

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Electromyography is defined as the recording and study of intrinsic electrical properties of the skeletal muscles by means of surface or needle electrodes, to determine whether the muscle is contracting or not, to study the action potentials spontaneously present in a muscle or induced by voluntary contractions.

The masticatory function with mandibular implant-supported overdentures fitted with different attachment types (magnet, ball and bar-clip attachment) was investigated. The result revealed that, the muscle activity was significantly lower for the unsupported mandibular denture compared with values for the supported denture. There were no significant differences in muscle activity among the three attachment types [(4)]

Aim of the study

The aim of the present study is to evaluate and compare the electromyographic muscle activity of both the buccinator and temporalis muscles in patients wearing implant supported over-dentures using different types of attachments namely: Bar attachments, magnet and locator attachments.

MATERIALS AND METHODS:

Fifteen Completely edentulous patients were selected from Out Patient Clinic, Prosthodontic Department, Faculty of oral and dental Medicine, Cairo University, all patients were apparently in good general health, free from debilitating diseases, physically and psychologically able to tolerate conventional surgical protocol, non- smoking, and their ages ranged between 40-60 years. Selected patients were examined orally and generally with full medical and dental history reports, as well as, radiographic records. Patients were asked about the cause and date of extractions, whether the cause was due to caries or periodontal disease. Intraoral examination and digital examination were done included Palpations of alveolar ridge (ridge height and width) at prospective implant side were performed. Gingival quality as well as mucosa overlying the area of prospective implants were examined.

Patients grouping:

Patients were divided into three groups according to method of treatment plane, as follows: ***Group A***: received implant supported overdenture with bar attachments. ***Group B***: received implants supported overdenture with magnet attachments, and ***Group C***: received implants supported overdenture with locator attachments, in each group, the implants were placed in the canine region.

Radiographic examination:

Preoperative digital panoramic radiographs were made to evaluate bone quantity at the edentulous ridge area and to detect presence of impacted teeth, remaining roots or any pathological lesions of the mandible.

Steps of prosthetic construction: The pre-surgical preparation required the construction of conventional complete denture. If the patient's old denture was judged satisfactory regarding the tissue adaptation, occlusion and esthetics, construction of the new dentures was skipped.

The mandibular denture was duplicated into clear acrylic resin using alginate impression material. This duplicate was used as radiographic and surgical stent.

Two stainless steel balls 4mm in diameter were fixed in the canine regions with sticky wax and a panoramic radiograph was made in order to assess the exact bone height at the selected implant sites with the radiographic stent. The radiographic stent was modified to act as a surgical stent. The surgical

stent was stored in 0.2% Chlorhexidine solution till the time of surgery.

Pre-surgical preparation: The patient was instructed to rinse with 0.2% Chlorhexidine mouth wash 3 times per day starting 2 days before surgery. One day before surgery, the patient was pre-medicated by a prophylactic dose of 625mg of a combination of Amoxicillin and Clavulinic acid and 400mg of non- steroidal anti-inflammatory analgesic***. Infection control measures were strictly followed, involving sterilization of the basic surgical instruments and the implant surgical kit. Patient was anaesthetized by infiltration field block anesthesia. For each group, fixtures installation using acrylic resin surgical template "flap technique were done. Surgical template was fabricated upon a study cast to aid in the placement of the implants in the canine regions.

Surgical installation of implants (First stage surgery): After anesthesia was achieved, the surgical guide was used to mark the proposed implant sites at equal distance from the midline.

The markings were limited to a distance between 16 mm and 26 mm corresponding to the prefabricated bar length according to the arch curvature. A full thickness mucoperiosteal flap was reflected exposing the bone. The flap consisted of a crested incision extending about 5 mm distal to the proposed implant sites with two short vertical incisions at both ends. The bony crest was inspected for any irregularities which were smoothed with bone file when necessary. The implants positions and directions were verified with the surgical stent. The direction of the preparation was corrected if necessary, a round bur was used to mark the implant site guided by the surgical stent. Under continuous flow of a sterile saline coolant, the preparation started with the 2 mm diameter pilot drill, to a depth of 12 mm parallel to the midline in both implant sites fig.(1). Widening of the initiated hole was then performed by the 3.2mm diameter spiral drill to establish the proper depth, and then by the 3.7mm cutting drill until the final sizing was performed end. Two paralleling tools were used to check the alignment of the osteotomy preparations in relation to each other and to the mid- line. The drilling was performed at 800 r.p.m speed with in and-out intermittent Pressure under external saline irrigation. Finally, after the implant site preparation was finished, the implant was picked up from the inner sterile vial with the octa-driver and directly inserted into the prepared site without touching any surface. The implant was manually threaded without irrigation until resistance was felt and then slowly threaded into its final position with a torque wrench until the implant top was flush with the ridge crest. The mucoperiosteal flap was repositioned and sutured with 3-0 interrupted black silk suture.

Patients were instructed to follow the post-operative instructions. Three months following surgical implant installation, patients were recalled for the second stage surgery and prosthetic phase, the implants were relocated using the surgical template, the implants cover screws were exposed by short crested incisions under local anesthesia guided by the surgical stent. The cover screws were loosened using the hex driver followed by healing abutments which installed for two weeks, later the healing abutments were replaced with the appropriate extension abutments. The dentures were delivered to the patients two weeks later, after the soft tissue healing and sutures removal.

For group A: Patients received implant retained mandibular overdenture with bar attachments were placed and their pickup in the denture was performed.

Group B: Patients in this group received implant retained overdenture with magnetic attachments and direct pick up was performed directly in the patient's mouth. ***Fig. (1)***

Fig. (1) Magnetic attachments inside patients mouth

Group C: Patients in this group received implant retained overdenture with locator attachments and direct pick up was performed directly in the patient's mouth.

The electromyography of buccinators and temporalis muscles was carried out at delivery of complete dentures then after one month's wearing period. Muscular activity evaluation: The muscular evaluation was performed in each phase during the study. Muscular activity, represented by the root mean square value (RMS), was evaluated by using a digital electromyogram (EMG)*,The position of the surface electrodes on the anterior temporalis and the buccinators muscles were marked on the patient's face by selecting the maximum bulging of the muscle fibers while the patient performed intermitted clenching.

Muscle activity was recorded during chewing equally sized pieces of carrot as hard food. Measurements were displayed and saved on a computer. Maximum Voluntary Teeth Clenching (MCV): Data Collection Surface EMG activity of the right and left buccinators and temporalis muscles were recorded during the performance of maximum voluntary teeth clenching (MVC), with the patients clench in the intercuspal position (ICP). The patients were asked to clench as hard as possible and to maintain the same level of contraction for two seconds. Next the patient was asked to relax the muscles, slightly separating the teeth for another two seconds. The test was repeated four times with all the time controlled by the operator. During these tests, the patients were verbally encouraged to perform at their best. The electrical activity was recorded at four time points 2, 4, 6 and 8 seconds.

Chewing data collection: Surface EMG was recorded from the right and left buccinator and temporalis muscle during unilateral (right and left) chewing of 3-4 pieces of carrot of suitable size. For each patient, the EMG potentials produced in the first 15second of each unilateral chewing were recorded. Data Analysis- EMG Power Spectrum: From the surface EMG recordings of each muscle and test (MCV and Chewing) a Fast Fourier Transform (FFT) was carried out using the software of the electromyography. The mean value of the EMG activity of each muscle was calculated from the Root Mean Square (RMS) amplitude in micro-volts (uV). Data from the three groups was collected, tabulated and statistically analyzed.

RESULTS

Electromyographic records

The electromyography records obtained were expressed as means and standard deviations (SD) of bar, magnet and Locator® attachment at fixed follow up periods (baseline and one months after).

Effect of time was evaluated using independent t test. There was insignificant difference for all groups during chewing and clenching as P-value > 0.05, listed in table (1, 2) and showed in figure (1).

For comparison between all groups, One way analysis of variance (ANOVA) test was performed followed by Tukey`s post hoc test for multiple comparisons which revealed that there was insignificant difference between all groups as P value > 0.05, listed in table (1,2) and showed in figure (1).

TABLE (1) Mean (M), standard deviation (SD) values of EMG values of buccinator muscle for all groups in relation with time during chewing:

M±SD	Buccinator during chewing			
	Bar Attachment	Magnetic Attachment	Locator ® Attachment	P-value
Base Line	92.8[a] ±5.54	100.2[a] ±7.31	98.1[a] ±3.62	**0.0676***
One Month After	87.6[b] ±4.81	94[b] ±6.74	93.7[b] ±4.82	**0.076***
P-value	**0.0853***	**0.1249***	**0.0774***	

M; Mean, SD; Standard Deviation, P; Probability Level

Same superscript letter in the same row indicated insignificant difference

**** Insignificant Difference***

TABLE (2) Mean (M), standard deviation (SD) values of EMG values of buccinator muscle for all groups in relation with time during clenching:

M±SD	Buccinator during clenching			
	Bar Attachment	Magnetic Attachment	Locator ® Attachment	P-value
Base Line	96.3[a] ±6.14	109.6[a] ±12.3	104[a] ±5.2	**0.07***
One Month After	91.7[b] ±8.35	102.1[b] ±7.9	97.5[b] ±6.3	**0.06***
P-value	**0.2631***	**0.1996***	**0.06***	

M; Mean, SD; Standard Deviation, P; Probability Level

Same superscript letter in the same row indicated insignificant difference

**** Insignificant Difference***

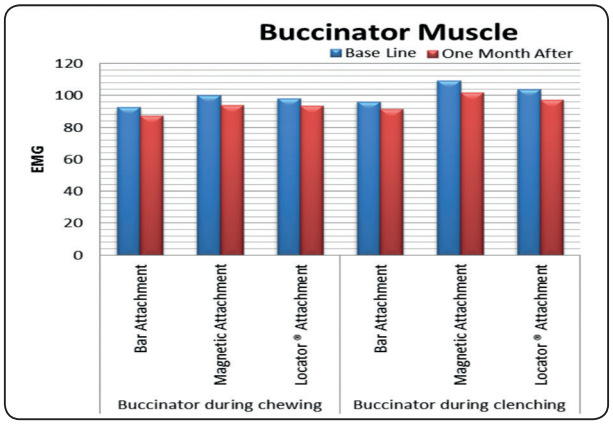

Fig. (1): EMG values of buccinator muscle for all groups in relation with time during chewing and clenching 2.Electromyographic records of Temporalis muscle:

The electromyography records obtained were expressed as means and standard deviations (SD) of bar, magnet and Locator® attachment at fixed follow up periods (baseline and one months after).

Effect of time was evaluated using independent t test. There was insignificant difference for all groups during chewing and clenching as P-value > 0.05, listed in table (3, 4) and showed in figure (2).

For comparison between all groups, One way analysis of variance (ANOVA) test was performed followed by Tukey`s post hoc test for multiple comparisons which revealed that there was insignificant difference between all groups as P value > 0.05, listed in table (3,4) and showed in figure (2).

TABLE (3): Mean (M), standard deviation (SD) values of EMG values of temporalis muscle for all groups in relation with time during chewing:

M±SD	Temporalis during chewing			
	Bar Attachment	Magnetic Attachment	Locator ® Attachment	P-value
Base Line	113.9[a] ±9.21	122.16[a] ±8.3	117.3[a] ±11.3	**0.3***
One Month After	108.1[b] ±7.013	117.7[b] ±8.03	113[b] ±6.22	**0.065***
P-value	**0.2327***	**0.327***	**0.3951***	

M; Mean, SD; Standard Deviation, P; Probability Level

Same superscript letter in the same row indicated insignificant difference

**** Insignificant Difference***

TABLE (4): Mean (M), standard deviation (SD) values of EMG values of temporalis muscle for all groups in relation with time during clenching:

M±SD	Temporalis during clenching			
	Bar Attachment	Magnetic Attachment	Locator ® Attachment	P-value
Base Line	119.42[a] ±8.72	128.65[a] ±7.43	126.5[a] ±12.4	**0.2***
One Month After	115.34[b] ±9.51	123.81[b] ±8.54	121[b] ±8.67	**0.2219***
P-value	**0.4192***	**0.2801***	**0.3552***	

M; Mean, SD; Standard Deviation, P; Probability Level

Same superscript letter in the same row indicated insignificant difference

**** Insignificant Difference***

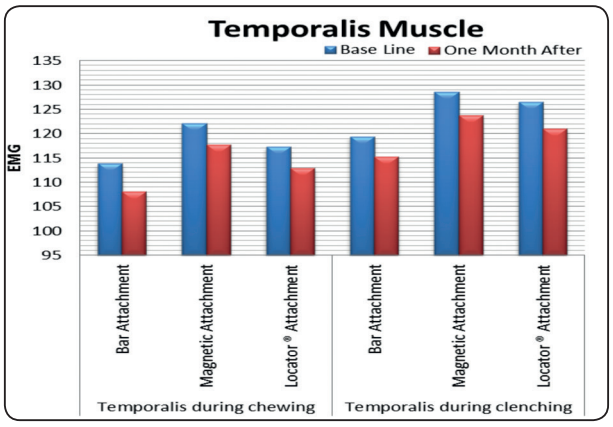

Figure (2): EMG values of temporalis muscle for all groups in relation with time during chewing and clenching

DISCUSSION

The purpose of this study was to solve problems of conventional compete denture, by following a recent modality using an implant-supported mandibular overdenture retained with different types of attachments, bar attachment, magnet attachment, and locator attachment to compare the electromyographic muscle activity of both on the buccinators and temporalis muscles.

Twenty one patients with completely edentulous mandible were included in this study, the mean age of the selected patients was 50 years, The patient's gender wasn't considered as an influencing factor

during the setup of the inclusion criteria, Patients in this study work were selected and examined medically, as well as orally, in order to exclude any criteria that may affect the success of osseiointegrated implant, [5] reported that the presence of some systemic diseases may affect the healing process, the rate of bone resorption and may create any complications during surgery. After carrying out thorough examination for all completely edentulous patients, prosthetic procedures were started.

Tentative jaw relations have been made to the patients to ensure an interarch space not less than 12mm which is the minimum space required to accommodate for the denture teeth and acrylic resin base strength and attachment retainer [6]. Moreover, it helped in determination of ridge relationship where patients only with Angle class I were included in the study to facilitate implant insertion and avoid implants overloading[7] implants ideal position ensures favorable force direction on both the implants and the prosthetic components. Therefore, the patients' dentures were duplicated to act as radiographic as well as surgical templates after modification[8]**.** The templates contained metallic balls to reveal the degree of magnification of the panoramic radiograph and to facilitate the evaluation of the available bone and its proximity to vital structures as the mental foramina.

The surgical procedures were done under complete aseptic conditions to control infection during and after implant installation. Pre-surgical antibiotics and chlorhexidine were prescribed to the patients to reduce the bacterial load and prevent infection during the initial healing period from the surgical wound site. [9] demonstrated that a significant decrease in implant failure occurs with the use of preoperative antibiotics. the proper control of frictional heat generation during surgical procedure was carefully considered for the preservation of the surrounding bone cells at the sites [10]**.**

For selected groups, ***attachments*** fabricated by pitt-easy company, the direct pick up techniques is simple, economic, quick, and allows the patient to retain the prosthesis [11] Moreover, rider pick up was carried out after impressions and denture fabrication to enhance the passive fit which is an important requirement for successful osseointegration. The pick-up procedures were carried out under biting forces to allow the metal caps contact with the female abutments [12]**.**

The electromyography of the buccinators and temporalis muscles carried out at the delivery of complete dentures then after one month's wearing period throughout the three main phases as the neuromuscular adaptation to new denture was proved to be achieved after one to three months wearing period. [13].

The root-mean-square value was a parameter frequently chosen because it reflects the level of the physiological activities in the motor unit of the muscle during contraction.[14].

The test food particles were nearly standardized in size to eliminate the influence of different food size on muscle activity.[15].

Results of this study revealed a statistically non-significant difference in muscular activity between usage of bar-clip , magnet attachments and locator attachments retaining the implant supported overdenture and this was approved with many studies [16]**.** Also, no large differences in maximum bite force and muscle activity were found among those types of attachment as the muscular activity is more related to support rather that type of attachment.

CONCLUSION

From the present study we conclude that there was no significant difference between bar and magnet and locator attachments regarding the muscular activity measured.

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