AL-AZHAR
Assiut Dental Journal

The Official Publication of The Faculty of Dental Medicine, Al-Azhar Assiut University, Egypt

AADJ, Vol. 5, No. 1, April (2022) — PP. 21:28
ISSN 2682-2822

The Role of Two Overdenture Attachments on The Bone Density Changes Around Implants Retained Mandibular Overdenture in Entirely Edentulous Patients

Reem M Abdeen[1], Ahmed M Shoeib[2], Ahmed A Shon*[2], Maie M Shaker[3]

Codex : 03/2022/04

Aadj@azhar.edu.eg

ABSTRACT

Aim: The purpose of this study was to evaluate the effect of attachments (equator and ball and socket) on the bone density changes around implants in the mandibular overdentures. **Subjects and Methods**: Sixteen completely edentulous patients aged 50 to 60 years old were selected for this study. According to the treatment protocol, the patient had a mandibular implant-retained overdenture at the canine area, and the patients were randomly divided into two equal groups. Group 1: Eight patients had two mandibular implant-retained overdentures with equator attachments, and group 2: Eight patients with ball and socket attachments. The bone density is measured in greyscale (Hounsfield units) using a partial scan Cone Beam Computed Tomography (pCBCT) after one week (baseline), six, twelve, and eighteen months of the insertion of the attachment. The mean values of bone density were compared between two groups, and between the different times within each group. Comparison between the two groups was made using an independent t-test, and multiple comparisons between times were made by one-way ANOVA with posthoc turkey test ($p< 0.05$). **Results:** The results didn't show any statistically significant difference between groups during all the follow-up times. Within each group, the readings were statistically significant from the baseline and with each other. **Conclusions**: The results of this study showed that the bone density around the implant overdenture increased significantly with time irrespective of the type of attachment used.

KEYWORDS

Bone Density, Implant-retained overdenture, Equator, Ball and socket, CBCT.

1. Department of Removable Prosthodontics, Faculty of Dentistry, Misr International University, Obour, Egypt..
2. Department of Removable Prosthodontics, Faculty of Dental Medicine, (Cairo, Boys), Al-Azhar University, Egypt.
3. Department of Removable Prosthodontics, Ministry of Electricity and Renewable Energy, Cairo, Egypt.

* Corresponding Author e-mail: Ahmedshon@azhar.edu.eg

INTRODUCTION

Implant-retained overdentures offered many advantages above the conventional complete dentures, including reduced denture movements, decreased residual ridge resorption, better esthetics, occlusion, and increased occlusal function. Additionally, implant-retained overdentures improve patient's speech and psychological condition. A mandibular implant retained-overdenture is less expensive than a fixed implant-retained prosthesis making this treatment more obtainable for edentulous patients [1, 2].

The use of two implants is usually considered the gold standard for treating the edentulous mandible due to the effectiveness on chewing, nutrition, the general quality of life, and the balance with the patient preferences, expectations, treatment plan, and expected costs [3,4]. Two attachments implant-retained mandibular overdentures are functionally superior to conventional dentures and are more effective and cost-saving replacements to fixed implant dental prostheses. The two-implant overdenture used in the mandible is the least cost implant and offers a significant increase in stability and retention over complete denture modality [5, 6].

Many attachments can be used to retain a mandibular denture to dental implants, including ball and socket attachments, bar-clip, magnets, locator, and equator attachments. Selection of the attachment type for an implant-retained overdenture depends on the amount of retention needed, amount of available residual ridge, oral hygiene, cost, patient's expectation and social status, maxillary- mandibular relationship, and status of the opposing arch. These different types of attachments have the same objective to stabilize and secure the complete denture; however, each mechanism has its own limitations[7,8]. The locator attachment system consists of an abutment attached to the implant and contains a matrix. It also has a patrix that is housed in a metal cap and provides retention. The cap is attached to the fitting surface of the denture and is made of titanium alloy. The patrix head provides frictional retention[9,10]. Equator attachment is as locator attachment is a new system with low profile configuration. These attachment types have different colours with different retention values and vertical heights, and their repair and replacement are fast and easy. The use of ball and socket attachment affords a more simplified method to stabilizing mandibular denture; it is a simple type of attachment due to its shape (male unit soldered to the dowel coping and female part embedded within acrylic resin of the prosthesis). Retention is obtained by a snap like action friction between patrix and matrix when the overdenture is inserted. [11]

The strength of bone is in a straight line related to bone density. The modulus of elasticity, bone contact, and axial stress contours around the implant is mainly affected by bone density. The primary bone density helps in the mechanical hold of the implant during healing. It also permits the transmission and distribution of stresses from the prosthesis to the implant-bone interface after osseointegration[12]. Bone density is the amount of bone tissue in a specific volume of bone. Valuation of bone density may be considered necessary in many cases such as systemic and oral diseases, implant planning, and therapeutic evaluation and follow-up. In the recent literature, several approaches have been introduced to measure mandibular and skeletal bone density. Follow-up studies of the bone density changes are not well documented [13].

Therefore, this study's objective was to determine the changes in bone density around the implants in the complete mandibular overdenture over eighteen months with two types of attachments: equator attachments and ball and socket attachments.

PATIENTS AND METHODS

Patient selection

Sixteen completely edentulous patients aged 55-60 years old were selected for this study from the output clinic of Removable Prosthodontics, Faculty of Dental Medicine, Al-Azhar University Cairo, Egypt. All patients were free from any systemic disease as confirmed by history taking and laboratory examinations. All patients were without any noticeable signs and symptoms of stomatognathic system disorder. All selected patients wore dentures before and had no abnormal habits such as bruxism, clenching, and tongue thrusting. They also did not take drugs that affect bone quality or quantity, with adequate mandibular bone dimensions for implant insertion. Each patient received a written consent explaining the study description. Cone-beam

computed tomography (CBCT) was made for each patient before implant insertion to determine the height and width of bone and the size of the proposed implant at specific sites.

Patient grouping

The patients were randomly group into two groups:

(Group 1) Eight patients had mandibular implant-retained overdenture at the canine region with two equator attachments.

(Group 2) Eight patients had mandibular implant-retained overdenture at the canine region with two ball and socket attachments.

Prosthetic and Surgical procedures

Each patient had complete upper and lower acrylic resin dentures made with the conventional protocol. The finished overdentures were inserted into the patient's mouth and checked for retention and occlusion, final adjustments were made, and the patients were instructed to care for and use their prostheses. The surgical procedures of implant insertion were done using a two-stage technique: A mucoperiosteal flap was reflected, and drilling of the bone was done at the canine area at 1000 rpm and 35 N.cm torque with copious saline irrigation. All implants were inserted using a hand piece with insertion speed 20 rpm and torque of 40 N.cm. The cover screw is placed over the implants and the flap is sutured. The system used in this study was a neoss proactive implant (Harrogate, UK) with 11mm length and Ø3.5mm diameter. Post-surgical medications were instructed to the patients as the following: Co-amoxiclav antibiotic (amoxicillin 750mg and clavulanic acid 125mg) two times daily, and anti-anaerobes (metronidazole 500mg) three times daily for at least seven days, and analgesic (diclofenac sodium 75mg) when needed. The patients were not allowed to wear their dentures for two weeks after surgery. Then, the dentures were relieved at the implant areas to be seated properly in the patient's mouth. A healing period of three months was allowed to assure complete osseointegration.

Second stage surgery was carried out after three months of implant insertion. The attachment installation (Neoss ball or equator attachment, Harrogate, UK) and pick up technique was done by auto polymerized acrylic resin (Figure 1). Any necessary adjustments were made, and then the dentures were finished and polished.

Partial scan cone-beam computed tomography (Partial scan view) for the implant site only was done after one week (baseline), 6, 12, and 18 months of implant insertion. All pCBCT images were scanned at the same imaging apparatus (Carestream CBCT, Kodak, USA) and imaging parameters (90Kvp, exposure time 35 seconds, milliamp 12.5, and voxel size 280). The alveolar bone density in greyscales

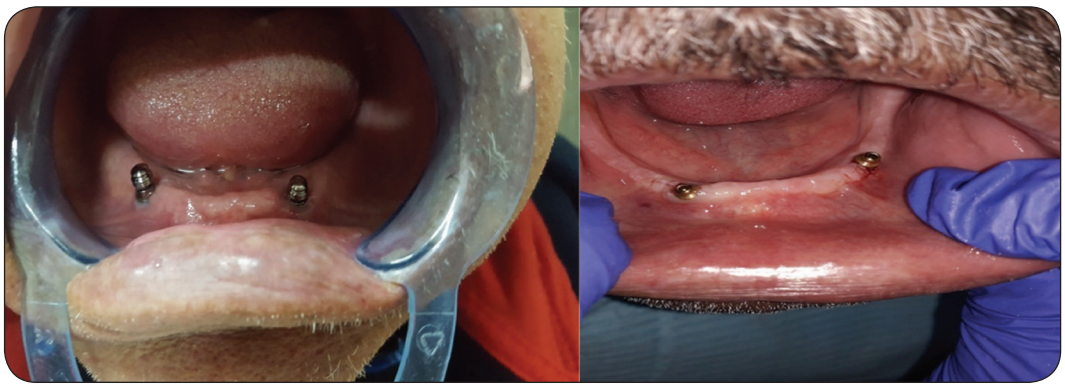

Fig. (1) Left: Two ball and socket implant attachments. Right Equator attachments

(Hounsfield unit scale) representing the bone density around the implant is calculated from the CBCT Software (In vivo imaging software, Kavo imaging, Biberach, Germany). Measurements were taken 1mm away from the implant, and three values were taken at the implant's top, bottom, and half. The average value of both mesial and distal sites was calculated, and the same was done for buccal and lingual sites. The following was measured: 1) bone density changes by time in each group, and 2) Bone density changes between the two groups.

Statistical Analysis

Numerical data were explored for normality by checking the data distribution and using the Kolmogorov Smirnov normality test. Data showed a normal (parametric) distribution. Data were presented as mean and Standard Deviation (SD) values. An independent t-test was used to compare the bone density change between attachments. One-way ANOVA with post hoc turkey test was used for multiple comparisons between times. The significance level was set at $p \leq (0.05)$. Statistical analysis was performed with IBM SPSS© Statistics Version 20 for Windows.

RESULTS

The mean values of average bone density Mesiodistally and Buccolingually are shown in (Table 1) and (Figure 2).

The mean bone density from the baseline was higher in group I in both mesiodistal and buccolingual sites (Fig. 3). However, the independent t-test between the two groups showed no statistically significant difference at any observation times (Table 2).

The amount of bone density was increased with time in the two groups. Within each group, the paired t-test showed a statistically significant difference in bone density between the baseline and the other observation times, indicating increase in bone density with time. (Table 3).

Table (1) *Mean values of bone density for both groups in Hounsfield units*

	Site	Group 1 (Mean ±SD.)	Group II (Mean ±SD.)
Baseline	**Mesial-Distal**	126.36±17.38	83.47±11.91
	Buccal-Lingual	115.39±25.61	96.13±20.58
6 months	**Mesial-Distal**	273.64±35.98	179.25±25.99
	Buccal-Lingual	236.34±52.96	204.63±43.69
12 months	**Mesial-Distal**	429.87±57.38	317.98±78.21
	Buccal-Lingual	387.45±67.17	362.04±57.36
18 months	**Mesial-Distal**	557.02±43.86	436.37±65.78
	Buccal-Lingual	532.67±62.53	466.92±41.76

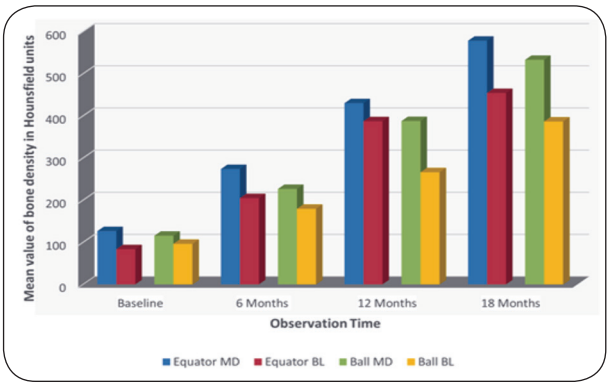

Fig. (2) Mean values of bone density for both groups in Hounsfield units

Table 2 *Comparison of Mean difference of bone density change around different attachments in Hounsfield units*

	Group I Mean ± SD.	Group II Mean ± SD.	p*	Significance
		Mesial-Distal		
Baseline	126.36 ±17.38	83.47 ± 11.91	0.07	NS
6 months	147.3 ± 37.55	121.0 ± 47.00	0.257	N.S
12 months	303.5 ± 59.64	234.5 ±85.06	0.106	N.S
18 months	430.7±63.6	352.9 ± 74.51	0.057	N.S
		Buccal-Lingual		
Baseline	Buccal-Lingual	115.39 ± 25.61	0.38	N.S
6 months	121.0 ± 67.5	108.5 ± 37.45	0.679	NS
12 months	272.1 ± 89.64	265.9 ± 61.51	0.883	NS
18 months	417.3 ± 65.54	371.8 ± 111.28	0.164	NS

**Independent t-test for comparison at (p <0.05). Results with NS means non-significant*

Table (3) *Paired t-test of bone density change by time at different sites*

		Mesial-Distal				Buccal-Lingual			
		Group I		Group II		Group I		Group II	
		p*	Significance	p*	Significance	p*	Significance	p*	Significance
Baseline	6 months	0.0001	Significant	0.0002	Non-Significant	0.0003	Significant	0.0002	**Significance**
	12 months	0.0003	Significant	0.0001	Significant	0.0001	Significant	0.0002	**Significance**
	18 months	0.000001	Significant	0.0002	Significant	0.000002	Significant	0.00011	**Significance**
6 months	12 months	0.0088	Significant	0.0007	Significant	0.001	Significant	0.0016	**Significance**
	18 months	0.0002	Significant	0.0005	Significant	0.00008	Significant	0.0011	**Significance**
12 months	18 months	0.03	Significant	0.001	Significant	0.001	Significant	0.004	**Significance**

**One-way ANOVA with posthoc turkey test for comparison at (p <0.05).*

DISCUSSION

This study objective was to compare the effect of two different types of attachments retained implant-retained mandibular overdentures on bone density. Mandibular implant-retained overdenture is an effective treatment option for edentulous patients. It is valuable to analyze the factors affecting its success in the long term [14].

Generally, all patients were free from systemic disease that might interfere with the implant surgical procedure or affect post-operative healing. Residual ridges had normal morphology, free from severe bony undercuts or flabby tissues, and covered by firm mucoperiosteum. Healthy firm, fixed mucosa around endosteal implants is considered a requirement for reliable long term [15,16].

Ball and socket and equator overdenture attachments used in this study were chosen due to simplicity in design [17]. The Equator attachment system offers the lowest profile attachment system in the market, giving superior design options for aesthetics and function, especially if available space is a problem [18,19]. Regarding technical complications, the equator attachments have fewer complications than the ball and socket attachments. A finite analysis showed more probability of excessive forces and fractured screws in ball attachments than other types of attachments [20]. Indeed, El-Sayed et al. found that mandibular denture base deformation was more significant in implant-retained mandibular overdenture with ball attachment than locator attachment [21]. Cakarer showed that locator attachments have fewer prosthetic complications than locator bar attachments [22].

Cone-Beam Computed Tomography(CBCT) is the chosen option for implant dentistry as it provides better measurement accuracy than two-dimensional imaging while using lesser doses of radiation. It was reported that both Cone-Beam Computed Tomography yielded sub-millimetre accuracy for implant measurements. The ridge width pattern cannot be viewed on two-dimensional imaging, but the CBCT benefits viewing the alveolar ridge from all directions. Cross-sectional images provide the implantologist with ridge details such as irregular or knife-edge ridge and narrow crestal ridge. Likewise, loss of cortical plates can also be evaluated on cross-sectional images. It was concluded that three-dimensional images reproduced actual osseous topography more accurately, and they considered it a valued diagnostic aid. The panoramic radiograph is an inefficient imaging technique, especially in resorbed mandible [23, 24].

Although the Dual Energy X-ray absorptiometry (DXA) was a popular imaging technique to measure bone mineral density, it has low-resolution two-dimensional imaging. On the other hand, CBCT provides a higher image resolution in three-dimensional imaging. Thus, CBCT has been widely used to diagnose complications in dental clinics [25]. Several studies have recommended using CBCT to evaluate the bone density in bone grafts and implants [26,27].

A significant increase in bone density around implants over time was observed in this study. This finding agrees with Lahori et al., who showed increased bone density over time with delayed and immediate loading implants. It has been demonstrated that denser bone surrounds well-retained implants in monkeys. Bone responds positively to the applied loads by applying for further support through its trabecular pattern and heavy lamina dura arrangement[28-30]. However, El-Rashedy showed non-significant changes in bone density between the first three months and the baseline in implant-retained Kennedy class IV cases [31]. This finding can be explained by the fact that the occlusal load is beard bore by implants. Meanwhile, in the present study, the ridge participates in support.

The results of this study showed no significant difference between equator and ball and socket attachment. This finding agrees with Wowern et al., who showed that the increase of the bone mineral content around implant-retained overdenture is independent of the attachment system over five years follow up. This explanation is supported by another study which showed that mandibular implant-retained overdenture by locator and ball attachment have the same clinical effect regarding chewing ability, retention, stability, gingival recession, comfort, and implant stability [32,33].

The study showed more bone deposition in the mesiodistal direction than the buccolingual one, which can be explained by the findings by Li et al., who concluded that the most areas that receive forces in the implant-retained overdenture were the distal neck of the most distal implant [34].

CONCLUSION

This study showed that the bone density around the implant overdenture increased significantly with time, irrespective of the type of attachment used.

REFERENCES

1. Nissan J, Oz-Ari B, Gross O, Ghelfan O and Chaushu G. Long-term prosthetic care of direct vs. indirect attachment incorporation techniques to mandibular implant supported overdenture. Clin Oral Implants Res 2011; 22:627-30.
2. Burns D, Unger J, Coffey J, Waldrop T, Elswick R. Randomized, prospective, clinical evaluation of prosthodontic modalities for mandibular implant overdenture treatment. J Prosthet Dent 2011; 106:12-22.
3. Visser A, Raghoebar G, Vissink A. Implant-retained mandibular overdentures versus conventional dentures: 10 years of care and aftercare. Int J Prosthodont 2006; 19:271–8.
4. Shor A, Goto Y and Shor K. Mandibular two-implant-retained overdenture: Prosthetic design and fabrication protocol. Compendium 2007; 28: 28-32.
5. Kleis W, Hartmann S, Al-Nawas B, Wagner W. A comparison of three different attachment systems for mandibular two-implant overdentures: one-year report. Clin Implant Dent Relat Res 2010; 12:209–18.
6. Ortegon S, Agar J, Taylor T, Perdikis D. Retention forces of spherical attachments as a function of implant and matrix angulation in mandibular overdentures: an in vitro study. J Prosthet Dent 2009; 101:231–8.
7. Pigozzo M, Henriques G and Vaz L. The service life of implant-retained overdenture attachment systems. J Prosthet Dent 2009; 102:74-80.
8. Rutkunas V, Mizutani H and Takahashi H. Influence of attachment wear on retention of mandibular overdenture. J Oral Rehabil 2007; 34:41–51.
9. Büttel A and Marinello C. Locator or ball attachment: a guide for clinical decision making. Schweiz Monatsschr Zahnmed 2009; 119:901-18.
10. Türk PE, Geckili O, Türk Y, Günay V, Bilgin T. In vitro comparison of the retentive properties of ball and locator attachments for implant overdentures, Int J Oral Maxillofac Implants 2014; 29:1106-13.

11. Michelinakis G, Barclay C, Smith P. The influence of interimplant distance and attachment type on the retention characteristics of mandibular overdentures on 2 implants: initial retention values. Int J Prosthodont 2006; 5:507-12.
12. Iplikçioglu H, Akça K, Cehreli M. The use of computerized tomography for diagnosis and treatment planning in implant dentistry. J Oral Implantol 2002; 28:29–36.
13. Celenk C, Celenk P. Relationship of mandibular and cervical vertebral bone density using computed tomography. Dento maxillofac Radiol 2008; 37:47–51.
14. Luk L, Pow E, Li T, Chow T. Comparison of ridge mapping and cone beam computed tomography for planning dental implant therapy. Int J Oral Maxillofac Implants 2011; 26:70-4.
15. Ericsson I, Johansson C, Bystedt H, et al. A histomorphoeteric evaluation of bone to implant contact on machine prepared and roughened titanium dental implants. Clin Oral Implants Res 1994; 5:202-6.
16. Meriscske S, Taylor T, Besler U. Management of edentulous patients. Clin Oral Implants Res 2000; 11:108-25.
17. Kendrick S and Wong D. Treatment options for edentulous mandible. Dent Today 2009; 28:74-6.
18. Kobayashi K, Shimoda S, Nakagawa Y, Yamamoto A. Accuracy in measurement of distance using limited cone beam computerized tomography. Int J Oral Maxillofac Implants 2004; 19:228-31.
19. Li B, Yao W, Jun L. A feasibility study of applying cone beam computed tomography to observe dimensional changes in human alveolar bone. J Zhejiang Univ-Sci B 2014; 15:398-93.
20. MacEntee M, Walton J, Glick N. A clinical trial of patient satisfaction and prosthodontic needs with ball and bar attachments for implant-retained complete overdentures: three-year results. J Prosthet Dent 2005; 93:28-37.
21. EL-Sayed M, Errabti H, Mustafa A. Mandibular Denture Base Deformation with Locator and Ball Attachments of Implant-Retained Overdentures. J Prosthodont 2016; 25:656-64.
22. Cakarer S, Can T, Yaltirik M, Keskin C. Complications associated with the ball, bar and Locator attachments for implant-retained overdentures. Med Oral Patol Oral Cir Bucal 2011; 16:953-9.
23. Weinländer M, Piehslinger E, Krennmair G. Removable implant-prosthodontic rehabilitation of the edentulous mandible: fiveyear results of different prosthetic anchorage concepts. Int J Oral Maxillofac Implants 2010; 25:589–97.
24. Kim G. Can dental cone beam computed tomography assess bone mineral density? J Bone Metab 2014; 21:117–26.
25. Badawy M, El-Sherbiny N. Effect of using soft liner on bone density around the abutments supporting complete lower overdenture. Egypt Dent J. 1992; 38:105-12.
26. Hao Y, Zhao W, Wang Y, Yu J, Zou D. Assessments of jaw bone density at implant sites using 3D cone-beam computed tomography. Eur Rev Med Pharmacol Sci 2014; 18:1398-403.
27. Salimov F, Tatli U, Kurkcu M, Akoglan M, Oztunc H, Kurtoglu C. Evaluation of relationship between preoperative bone density values derived from cone beam computed tomography and implant stability parameters: a clinical study. Clin Oral Implants Res 2014; 25:1016-21.
28. Lahori M, Kaul A, Chandra S, Nagrath R, Gupta H. A Comparative Evaluation of Crestal Bone Levels in Mandibular Implant-Retained Overdentures using Delayed and Immediate Loading Protocols: An in vivo Study. Int J Oral Implantol Clin Res 2012; 3:1-7.
29. Ogiso M, Tabata T, Kuo T, Borgese D. A histologic comparison of the functional loading capacity of an occluded dense apatite implant and the natural dentition. J Prosthet Dent 1994; 71:581-8.
30. Isidor F. Influence of forces on peri-implant bone. Clin Oral Implants Res 2006; 17:8-18.
31. El-Rashedy W, Shakal E, El Gendy M, Saudi H. Clinical and Radiographic evaluation of implant-retained removable partial overdenture in the lower Kennedy class IV cases. Tanta Dent J 2016; 13:1-10.
32. Wowern N, Gotfredsen K. Implant-retained overdentures, a prevention of bone loss in edentulous mandibles? A 5-year follow-up study. Clin Oral Implants Res 2001; 12:19-25.
33. Abo Shady M, Eltorky I, Abd-Eaal Z. Comparative study of two types of attachments for mandibular implant-retained single complete overdenture. Tanta Dent J 2016; 13:157-61.
34. Li K, Xin H, Zhao Y, Zhang Z, Wu Y. Remodeling of the mandibular bone induced by overdentures supported by different numbers of implants. J Biomech Eng 2016; 2:138.

النشر الرسمي لكلية طب الأسنان
جامعة الأزهر أسيوط
مصر

الأزهـــر
مجلة أسيوط لطب الأسنان

AADJ, Vol. 5, No. 1, April (2022) — PP. 28

دور اثنين من روابط الطقم الفوقى في تغير كثافة العظام حول غرسات ا لأسنان المحملةبالفك السفلى في المرضى الذين يعانون من فقد كلى للأسنان

ريم م عابدين1 , أحمد م شعيب [2], أحمد أ شون [*2], مي م شاكر [3]

1. قسم الاستعاضة الصناعية المتحركة، كلية طب الاسنان، جامعة مصر الدولية، القاهرة ، مصر
2. قسم الاستعاضة الصناعية المتحركة، كلية طب الاسنان، (القاهره ،بنين)، جامعة الازهر، مصر
3. قسم التركيبات الصناعية المتحركة، وزارة الكهرباء والطاقة المتجددة ، القاهرة ، مصر

* البريد الإلكتروني:AHMEDSHON@AZHAR.EDU.EG

الملخص :

الهدف: كان الغرض من هذه الدراسة هو تقييم تأثير روابط الطقم الفوقى (المستوية والكرة و الرابطة المستديرة أو الحلقية) على تغيرات كثافة العظام حول الغرسات في أطقم الفك السفلي.

المواد والاساليب: تم اختيار ستة عشر مريضًا يعانى كل منهم من فقد كلى للأسنان تتراوح أعمارهم بين 50 إلى 60 عامًا لهذه الدراسة. وفقًا لبروتوكول العلاج ، تم أستخدام غرستين عظميتين وضعت واحدة على كل جانب من جانبى الفك فى المنطقة الأمامية فى موضع الناب ، وتم تقسيم المرضى بشكل عشوائي إلى مجموعتين متساويتين. المجموعة 1: ثمانية مرضى لديهم طقم فوقى في الفك السفلي مع الروابط المستوية، والمجموعة 2: ثمانية مرضى لديهم طقم فوقى في الفك السفلي مع روابط الكرة و الرابطة المستديرة أو الحلقية. تم قياس كثافة العظام (HOUNSFIELD UNITS) GREYSCALE)باستخدام التصوير المقطعي المحوسب بالأشعة المخروطية الجزئية(P CBCT) بعد أسبوع واحد (BASELINE) ، وستة ، واثني عشر، وثمانية عشر شهرًا من إدخال الروابط. تمت مقارنة القيم المتوسطة لكثافة العظام بين مجموعتين ، وبين الأزمنة المختلفة داخل كل مجموعة. تم إجراء مقارنة بين المجموعتين باستخدام اختبار INDEPENDENT T-TEST ، وتم إجراء مقارنات متعددة بين الأوقات بواسطة ONE-WAY ANOVAمع اختبار (P< 0.05 POSTHOC TURKEY TEST).

النتائج: لم تظهر النتائج أي فروق ذات دلالة إحصائية بين المجموعات خلال جميع أوقات المتابعة. داخل كل مجموعة ، كانت القراءات ذات دلالة إحصائية من BASELINE ومع بعضها البعض.

الخلاصة: أظهرت نتائج هذه الدراسة أن كثافة العظام حول الغرسات في أطقم الفك السفلي زادت بشكل ملحوظ مع مرور الوقت بغض النظر عن نوع الروابط المستخدمة.

الكلمات المفتاحية : أظهرت نتائج هذه الدراسة أن كثافة العظام حول الغرسات في أطقم الفك السفلي زادت بشكل ملحوظ مع مرور الوقت بغض النظر عن نوع الروابط المستخدمة , الاشعه المقطعيه المخروطيه.