ASDJ
AINSHAMS DENTAL JOURNAL

Print ISSN 1110-7642
Online ISSN 2735-5039

AIN SHAMS DENTAL JOURNAL
Official Publication of Ain Shams Dental School
March 2021 • Vol. XXIV

EFFECT OF DEGREE OF PALATAL COVARAGE OF IMPLANT RETAINED MAXILLARY OVERDENTURE ON THE CRESTAL BONE LOSS

Sawsan Maged Fadl [1]

Abstract

Objectives: To radiographically evaluate the effect of the degree of palatal coverage on crestal bone height around maxillary hybrid -implants.

Methods: Fourteen edentulous patients with conventional maxillary and mandibular complete dentures were included in this study. Four hybrid implants (one piece 3 mm in diameter, 12 mm in length) were installed in maxillary arch of each patient in areas of lateral incisors and first premolars to retain maxillary implant overdenture then the upper denture was modified by reduction of the palatal coverage area for half of the patients and was followed radiographically for one year.

Results: In this study, at the end of follow up period, there was statistically significant difference between the two groups regarding the average bone loss around the dental implants as shown by student t-test. The least bone loss was reported around the implants in group I. After six months, the mean differences of bone height loss were (0.745 ± 0.098) and (0.77 ± 0.051) mm while from six to twelve month, the mean differences of bone height loss were (0.50 ± 0.041) and (0.57 ± 0.036) mm in group I and group II respectively.

Conclusion: Bone height loss around implants was increased by reduction of the palatal coverage.

KEYWORDS: Maxillary implants- overdenture- palatal coverage- radiographic evaluation.

1. Lecturer of Oral and Maxillofacial prosthodontics Department, Faculty of Dentistry Ain-Shams University, Cairo, Egypt.

Introduction:

Traditional complete dentures are still the treatment of choice in many circumstances due to cost and biological considerations. However, dissatisfaction with complete dentures was reported by many patients. (1)

As compared to conventional dentures, implant supported overdentures had offered many benefits regarding retention, support, chewing and decreasing resorption of the residual ridge. (2)

Hybrid implants incorporate the best qualities of both traditional and small diameter implants, with diameters between 3 and 3.5 mm and variable lengths from 10 to 18 mm. (3)

A minimum of four implants is often recommended to support or retain maxillary overdenture. The increased number of implants in maxilla compared to the mandible is due to the decreased bone density, esthetic demands and bone angulations. (4)

Positioning the implants in anterior maxilla, till the first premolars enhances overdenture stability while placement in the posterior area will complicate the procedure due to diminished amounts of bone and also bone density is not favorable in such situation, bone augmentation procedure is required. (5)

Polymethylmethacrylate (PMMA) resin is the most popular material to be used as denture base. Acrylic resin's hardness is sufficient to evenly distribute loads to the underlying tissues and it may be coloured and characterized to meet the cosmetic needs of most patients. On the other hand, it is prone to unfavourable dimensional changes during processing which can affect the proper base adaptation and denture stability. (6)

Thermoplastic resins as an alternative for conventional denture base materials were introduced as prepacked PMMA capsules. The technology of their fabrication depends on plasticizing the material by thermal processing without any chemical reaction. The possibility of injecting the plasticized resin into a mold has created a new perspective to removable prosthodontics technology. It was revealed that injection molding techniques might result in fewer dimensional inaccuracies and more accurate denture base than conventional processing techniques. (7,8)

Palateless overdentures were declared to be less in weight, more comfortable, taste and temperature perception, as well as more effective during phonation, mastication and swallowing. (9)

Some researchers reported that palateless dentures are superior to conventional dentures as regard to oral function, gag reflex, patient satisfaction and sensorimotor function. (10, 11) It was proposed that using a minimum of four unsplinted implants with locator abutments to support palateless maxillary overdentures resulting in a 100% survival rate in one year to four years follow-up time. (12)

As conventional maxillary denture depends on the hard palate for good support and adaptation with well vestibular extension allowing adequate peripheral seal at the borders, so removal of the palatal coverage limits the space available for tissue support and may affect the vestibular seal of a maxillary denture. A maxillary complete denture's retentive quality has been demonstrated to suffer when the palatal covering is reduced. (13)

Hence, this study was done to asses which degree of palatal coverage causes less bone height changes of implant retained maxillary overdenture.

Materials and Methods:

This study was performed in the Removable Prosthodontic Department Faculty of Dentistry, Ain shams University. Fourteen patients were selected to share in this study, these patients were selected to be between the ages of 45-65. Inclusive criteria were: U-

shaped maxillary alveolar arches, Angle class I ridge relationship, adequate inter arch space and the lower arches were rehabilitated with implant retained overdentures.
V-shaped edentulous ridge, deficient amount of bone in the premaxilla (less than 14 mm length and 5 mm width), Angle class II and III ridge relation, patients suffering from neuromuscular diseases, and TMG disorders were among the exclusion criteria. Smokers and uncontrolled diabetic patients were also excluded.
Implant-supported maxillary overdentures manufactured of the thermoplastic biocompatible material "Polyan IC" were used to rehabilitate all of the patients in this study (Polyan IC, Modified methacrylate, Bredent, Germany).
Four hybrid implants were surgically installed in the maxillary ridges for all patients (two in the lateral region and two in the first premolar region).
The patients were divided into two equal groups: Group I: consists of seven patients, each patient received full palatal coverage maxillary implant retained overdenture.
Group II: consists of seven patients, each patient received partial palatal coverage maxillary implant retained overdenture.
For all the patients, maxillary complete dentures were constructed following the same traditional steps. The maxillary dentures were processed following the injectable moulding technique. (Bredent, Germany, Thermopress 400 version 2.4/2.56) **(fig1)**

Fig. (1) Injection molded denture.

In group II, removal of the palatal part was done by initially measuring the distance between the fovea palatine and midpoint of the incisive papilla (1-2), then the distance from the contact point between second premolar and first molar (3-4) to the median palatine raphe of the arch (7) bilaterally (3-7 and 4-7). At one third of these distances, another marks were done (5 and 6) on the both sides, also at one third the distance from fovea palatine and incisive papilla (8). The palatal extension was defined from line joining the 3 marks (5-8-6) till the posterior border. **(fig2)**

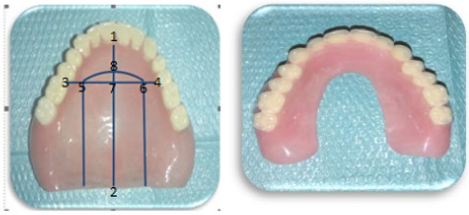


Fig. (2) Modification of the palatal part in group II

Cone beam computerized tomography (CBCT) was made for each patient to assess the approximate bone width and height at the proposed implant site. The radiographic diagnostic stent was converted into a surgical stent by drilling channels at the desired implant's location. Each patient received four implants (one-piece, ball type, 3 mm diameter, 12 mm length) (INNO SLA implants system. Co., Korea). The modified surgical stent was seated in the patient's mouth to indicate the location of the implant and the incision. The stent was then taken out. The implant surgeries were carried out.

After one week of surgery, implant loading was performed. On the fitting surfaces of the maxillary denture, areas opposing the placed implants were designated and reduced. The denture was placed in the patient's mouth to ensure

adequate intercuspation and perfect seating. The relieved regions were filled with duralay hard pickup material, and the denture was reseated in the patient's mouth. Acrylic resin that was not needed was removed. Patients were scheduled for follow-up appointments to assess the prosthesis and make any necessary changes. **(Fig 3)**

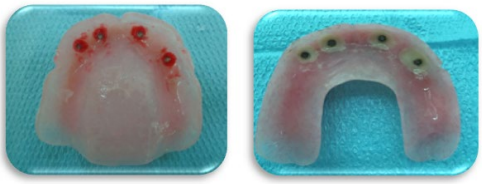
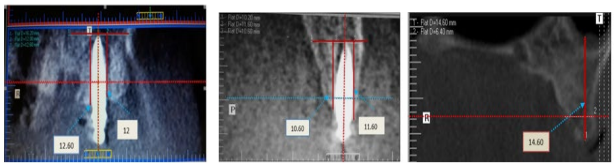


Fig. (3) Metal housing in proper position in group I, II

Assessment of osseointegration was done throughout the study period by observing signs of inflammation or infection and mobility. Follow up visits were scheduled at time of loading, six and twelve months after loading.

All patients' maxilla were scanned using computed tomography on the time of implant placement, six months, and twelve months later. The variations in bone height around each implant were evaluated. Radiographic evaluation was made using the linear measurement system in the Cone beam (CBCT). The bone height was measured from the apex of the implant to the crestal bone in contact with the implant using a ruler in the software. The distal part of the ridge was measured fifteen millimetres distal to the last implant in the right and left sides, with buccal and lingual bone height measured in sagittal view and mesial and distal bone height measured in coronal view. By calculating the difference in bone height at each interval from the base line measurement, the crestal bone loss at different intervals was obtained. **(Fig 4)**



A B C

Fig. (4) Measurement of bone height (A) in buccal and palatal surfaces (B) in mesial and distal surfaces (C) distal to the last implant.

Results:

Paired t test was used to compare the peri- implant bone height loss within each group through the follow up period. ANOVA test was used to asses the bone loss during the follow up period in buccal, lingual, mesial and distal surfaces in each group. Tukey Kramer's post-hoc test was used in the procedure of pair-wise comparison between means when ANOVA test is significant. The significance level was set at $P \leq 0.05$.

Student t test was performed to compare between the mean differences of total peri-implant bone height changes in the two studied groups, and the total bone changes on the distal part of the ridge, and the results were shown in table (1).

Table (1): Mean value (mm), standard deviation (SD) of peri- implant bone height change and bone changes distal to the ridge for group I and II patients during the follow-up periods.

Months	Group I		Group II		P value
	Mean difference	SD.	Mean difference	SD.	
0-6	0.745	0.098	0.77	0.051	0.43
6-12	0.50	0.041	0.57	0.036	0.004*
0-12	1.25	0.105	1.34	0.079	0.05*
0-12 (distal ridge)	1.08	0.172	1.27	1.44	0.034*

*SD.: standard deviation *: statistically significant* $P \leq 0.05$.

The mean difference total peri-implant bone height loss from insertion to six months was 0.745 mm ± 0.098 mm for group I and 0.77mm ± 0.051mm for group II, while the mean difference of the total peri-implant bone height loss in the following six months was 0.50 mm ± 0.041 mm for group I and 0.57 mm ± 0.036 mm for group II. Finally, the mean difference of

the total peri- implant bone height loss from loading to one year of follow up was 1.25 mm ± 0.105mm for group I and 1.34 mm ± 0.079 mm for group II. The mean difference of the total bone height loss of the distal part of the ridge from loading to one year of follow up was 1.08 ± 0.172 for group I and 1.27 ± 1.44 for group II.

The difference was found statistically significant between the two studied groups throughout the follow up period (six months to twelve months, and insertion to twelve months). However by using T test for comparison between groups I, II it was found that there was statistically significance difference at the distal surface of the implants all over the study period.

Discussion:

A Maxillary implant overdenture is a stabilized removable prosthesis used for rehabilitation of the edentulous maxilla that provides increased patient satisfaction and improved oral health. It should be designed to be maintainable, retrievable, repairable or replaceable. (14)

Long-term performance, stability, wear and deformation resistance, solvent resistance, and the absence or minimal quantity of residual monomer are all advantages of thermoplastic resins unlike the conventional acrylics. Furthermore, they have a lower porosity, which prevents the growth of germs and allows them to maintain their size and colour over time. They also have a high level of flexibility and resilience, thanks to the use of elastomers for added elasticity or fibreglass reinforcement. (8,15)

Polyan IC was selected to use as a denture base material in this study and processed by injection molding technique. It is a transparent glass-like thermoplastic maerial based on a polymethyl methacrylate. It is well tolerated and minimizes the occurrence of allergic reactions. Furthermore, this thermoplastic resin can be relined and repaired easily. (16)

Reducing the palatal coverage gives more room for the tongue, exposes additional palatal tissue for better appreciation of food texture and provides better comfort for complete denture wearers. (17) Implant overdentures with partial palatal covering were used to compensate for the lack of maximum palatal coverage, which reduced physical retention. A minimum of four implants is required for overdenture design with partial palatal coverage, so stresses over each implant are clinically acceptable. (12)

A significant decrease of marginal bone height surrounding the implants in all aspects (buccal, lin- gual, mesial and distal) for both groups was found throughout all time intervals during this study. This bone reduction might be due to surgical trauma, bone osteotomy and healing process. Also it might be regarded an initial bone reaction after the prosthesis was inserted, which was linked to the healing and rearrangement of the bone and periosteum following trauma as well as remodelling due to functional stresses following placement of the prosthesis. This also could be attributed to the micro-damage accumulation occurring in bone after implant placement. (18, 2)

Reduction of implant marginal bone level was declared in both groups but the mean values of bone loss agree with the success criteria and were previously observed to occur within the acceptable range during the first year of implant placement. (19) The marginal bone height reduction was high six months after loading after which the velocity of bone reduction tends to decrease. (20)

The increased loss of bone with passage of time would be due to increased mechanical loads that could lead to bone

resorption. These stresses may be related to the following factors: (1) very narrow maxillary bone trabeculae with absent cortical plate may subject the maxilla to higher biomechanical forces. (2) As hybrid implants have less mechanical anchoring and are loaded sooner during the healing period, they may result in increased bone loading, perhaps exceeding the physiologic limit. (3) Unsplinted implants also shows degree of disparallelism which produces micro-movement as a result of multiple insertions and removals of the prosthesis. [21, 22]

Till the end of the twelve months of the follow- up period, further reduction of the bone height might be due to mechanical factors acting on the implants: loading and forces of mastication. [19] Both study groups showed a decrease in bone height around the implants and this decrease was statistically significant at the end of the 12 months follow up period. A total change of 1.25 mm and 1.34 mm was detected for for group I implant supported maxillary overdenture with complete palatal coverage and group II implant supported maxillary overdenture with partial palatal coverage. This level of bone loss is within the acceptable limit for the first year following implant implantation. [19]

Partial palatal coverage demonstrated significant bone loss around implants when compared to complete palatal coverage. This result may be due to the fact that complete palatal coverage improves distribution of stresses between implant and adjacent soft tissues. While the absence of palatal coverage increase stresses around supporting implants, especially when there are risk factor, such as compromised bone quality and off-ridge relation. [23]

The distal implant and the distal part of the ridge showed a significantly more marginal bone reduction in complete palatal coverage (group I), and Partial palatal coverage (group II). The distribution is claimed to create hidden posterior cantilever situation and exaggerate more stresses around distal implants. The distal implant is found to tolerate strong compressive stresses and bending moments that are on average at least double the applied load. Thus care should be taken when planning four implant maxillary overdenture especially in cases does not permit more distal installation of implants for anatomical limitations. [24]

It was suggested that the absence of palatal coverage can represent a risk of implant failure when there is little bone, or if the bone is of poor quality. [22] Also, the palate may be used for support to decrease implant loading if four or fewer implants are used. [25]

Conclusion

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

1) Maxillary implant supported overdenture retained with four unsplinted hybrid implants with complete or partial palatal coverage can be used successfully in treatment of edentulous maxillary arch.
2) Maxillary implant supported overdenture with complete palatal coverage is more desirable treatment option than partial palatal coverage regarding the health of the supporting structure.

References

1. Albaker AM. The oral health related quality of life in edentulous patients treated with Conventional complete dentures. Gerodontology. 2013; 61–66.
2. Zarb GA, Bolender CL and Corlsson GE. Boucher's Prosthetic Treatment for Edentulous Patients. C. V. Mosby Co., Saint Louis. 1997; p.80.
3. Christensen GL. The "mini" mplant has arrived. J Am Dent Assoc. 2006; 137:387-390.
4. Slot W, Raghoebar GM, Vissink A, Huddleston Slater JJ, Meijer HJA. A systematic review of implant-supported

maxillary overdentures after a mean observation period of at least 1 year. J Clin Periodontol. 2010; 37: 98–110.
5. Kiener P, Oetterli M, Mericske E, Mericske-Stern R. Effectiveness of maxillary overdentures supported by implants: maintenance and prosthetic complications. Int J Prosthodont. 2001; 14:133–140.
6. Polychronakis N, Yannikakis S, Zissis A. A clinical 5-year longitudinal study on the dimensional changes of complete maxillary dentures. Int J. Prosthodont. 2003; 16:78-81.
7. Parvizi A, Lindquist T, Schneider R, Williamson D, Boyer D, Dawson DV. Comparison of the dimensional accuracy of injection-molded denture base materials to that of conventional pressure-pack acrylic resin. J. Prosthodont. 2004; 13:83-9.
8. Gharechahi J, Asadzadeh N, Shahabian F and Gharechahi M . Dimensional Changes of Acrylic Resin Denture Bases: Conventional Versus Injection-Molding Technique. Journal of Dentistry, Tehran University of Medical Sciences. 2014; 4: 11-398
9. El-Amier N, Elsaih E, Gibreel M and El-Motaiam H. Effect of implant location on palateless complete overdenture retention: An in vitro study. J Oral Maxillofac Res. 2018 ; 9: 3.
10. Singh K and Gupta N. Palateless custom bar supported overdenture: a treatment modality to treat patient with severe gag reflex. Indian J Dent Res. 2012; 23:145-8.
11. Kaiba Y, Hirano S and Hayakawa I. Palatal Coverage Disturbance in Masticatory Function. J Med Dent Sci. 2006; 53: 1–6.
12. Cavallaro JS Jrand Tarnow DP. Unsplinted implants retaining maxillary overdentures with partial palatal coverage: Report of 5 consecutive cases. Int J Oral Maxillofac Implants. 2007; 22:808-14.
13. Ochiai T, Williams H, Hojo S, Nishimura R and Caputo A. Photoelastic analysis of the effect of palatal support on various implant-supported overdenture designs. J Prosthet Dent. 2004; 91:421-7.
14. Sadowsky SJ, Zitzmann NU. Protocols for the maxillary implant overdenture: A systematic review. Int J Oral Maxillofac Implants. 2016; 31:182-191.
15. Huggett R, Zissis A, Harrison A, Dennis A. Dimensional accuracy and stability of acrylic resin denture bases. J Prosthet Dent. 1992; 68:634-40.
16. Senden KG and Shade W. Latest press release. Bredent Gr. 2013;49:22–4.
17. ELSyad M, Ghoneem NE and El-Sharkawy H. Marginal bone loss around unsplinted mini-implants supporting maxillary overdentures: A preliminary comparative study between partial and full palatal coverage. Quintessence Int. 2013; 44:45-52.
18. King GN, Hermann JS, Schoolfield JD et al. Influence of the size of the microgap on crestal bone levels in non submerged dental implants. J Periodontol. 2002;73: 1111-1117.
19. Cox J and Zarb G. The longitudinal clinical efficiency of osseointegrated dental implants. A 3-year report. Int J Oral Maxillofac Impl. 1987; 2: 91.
20. Cochran DL, Nummikoski V, Schoolfield JD. et al. a prospective multicenter 5-year radiographic evaluation of crestal bone levels over time in 596 dental implants placed in 192 patients. J Periodontol. 2009; 33: 725.
21. Jivraj S, Chee W et al. Treatment planning of the edentulous maxilla. Br Dent J. 2006; 201: 261-279.
22. Palmqvist S, Sondell K, Swartz B. Implant supported maxillary overdentures: outcome in planned and emergency cases. Int J Oral Maxillofac Implants.1994; 9 :184-190.
23. Jeong MK and Ok SH. Finite element analysis on stress distribution of maxillary implant-retained overdentures depending on the bar attachment design and palatal coverage. J Adv Prosthodont. 2016 ;8:85-93.
24. Saab XE, Griggs JA, Powers JMand Engelmeier RL. Effect of abutment angulation on the strain on the bone around an implant in the anterior maxilla: A finite element study. J Prosthet Dent. 2007; 97: 85-92.
25. Zitzmann NU and Marinello CP. Treatment plan for restoring the edentulous maxilla with implant-supported restorations: removable overdenture versus fixed partial denture design. J Prosthet Dent. 1999 ; 82:188-196.