1-2012

Comparative Study of OT Equator Profile Attachment Versus GPS Attachment in Implant Retained Mandibular Overdenture Cases

Fardos N. Rizk
The British University in Egypt, fardos.rizk@bue.edu.eg

EGYPTIAN DENTAL JOURNAL

VOL. 58, 1:10, JANUARY, 2012

I.S.S.N 0070-9484

WWW.EDA-EGYPT.ORG

COMPARATIVE STUDY OF OT EQUATOR PROFILE ATTACHMENT VERSUS GPS ATTACHMENT IN IMPLANT RETAINED MANDIBULAR OVERDENTURE CASES

Fardos N. Rizk*

ABSTRACT

Aim: This study was carried out to evaluate whether OT Equator Profile attachment or GPS attachment is less destructive to crestal bone around implants and to bone in distal aspect of the ridge in implant retained mandibular overdenture cases. ***Materials and Methods:*** Following two stage surgical protocol twelve completely edentulous patients received two implants placed bilaterally in the canine region (24 implants) to retain mandibular overdentures. Four months following the surgery patients were randomly divided into two equal groups; Group-I received OT Equator Profile attachment while Group-II received GPS attachment upon which mandibular overdentures were retained. Once patients were comfortable to the prosthesis, they were placed on zero, three, six and twelve months follow-up periods using cone beam computed tomography. Measurements were taken on crestal bone height surrounding the implants and on bone height at distal aspect of the ridge then the results were statistically analyzed. ***Results:*** OT Equator Profile attachment showed more crestal bone resorption than the GPS attachment however, there was no statistically significant difference between the two groups in bone resorption of distal aspect of the ridge. ***Conclusion:*** GPS is less destructive to crestal bone around implants however, there is no difference between using OT Equator Profile attachment or GPS attachment on bone height at distal aspect of the ridge.

KEY WORDS: Implants, GPS attachment, OT Equator Profile attachment, overdenture, cone beam computed tomography

INTRODUCTION

Today we are faced with the demand of creating a denture that by far surpasses the esthetics and function of dentures made in the past. Denture wearers want to look as if esthetic natural dentition is taking up the oral cavity. Implant-retained overdentures on two anterior implants meet patient's satisfaction in relation to esthetics and function. It provides significantly greater satisfaction, better quality of life and improved mastication in comparison to conventional denture thus it is recently recommended by panel of experts to become the standard of care for edentulism.[1-7]

* Lecturer, Prosthetic Dept, Faculty of Dentistry, Misr University for Science and Technology.

However, compared to conventional complete denture, an implant-retained overdenture requires more thorough planning.

An important consideration in fabricating a mandibular overdenture is ensuring sufficient space for the prosthetic components of the implant attachment system which is either bars or individual attachments. Inadequate space for prosthetic components can result in an over contoured prosthesis, excessive occlusal vertical dimension, fractured teeth adjacent to the attachments, attachments separating from the denture, fracture of the prosthesis and overall patient dissatisfaction. Consequently, prosthetic space analysis is critical when planning for a successful mandibular overdenture and this should be considered by both the prosthodontist and the implant surgeon. In this respect increasing the height of attachment, complicates the alignment also limited interarch space often restricts the prosthetic armamentarium to low-profile attachments and prevents using O-ring attachments and bars. [8-11] GPS and OT Equator Profile attachments provide low profile design which offers multiple solutions for overdenture treatment planning where inter-occlusal space limitations are considered. Both attachments are available in various degrees of retention and they have the advantage of being resilient thus transferring more occlusal load to the soft tissues and lowering the stress placed on bone surrounding the implants than rigid attachments. These attachments are also compatible with the hex tool which eliminates the need for special insertion tool as Locater attachment. One perceived advantage of GPS attachment is that it enhances esthetics by its pink anodized metal housing which blends with denture acrylic allowing natural profile with minimal acrylic facially.

Since the advent of osseo-integrated implants, many major innovations and improvements have taken place. Three dimensional computed tomography (CT) radiographic imaging and computer-assisted treatment planning software have revolutionized treatment planning and surgical placement of implants.[12-14] Cone beam Computed Tomography (CBCT) accurately pinpoints vital structures and evaluates the surgical site underneath the soft tissues making it possible to pre-surgically determine with a high degree of accuracy and with 3D views the best position for implant placement and to plan the implant position and inclination, based on the final prosthetic outcome. [15-17] By using CBCT, anatomic limitations and bone morphology can be evaluated precisely. [18-20] When compared to traditional CT scanning, CBCT scanning, utilizes less than 2% of the radiation, provides more accuracy in the area of interest, and is safer for the patient.[21] In this respect CBCT holds promising potential for oral and craniofacial imaging applications.

This study was conducted to evaluate which solitary attachment; OT Equator Profile or GPS is less destructive to crestal bone around implants and to bone in distal aspect of the ridge in implant retained mandibular overdenture cases using CBCT.

MATERIALS AND METHODS

Patients Selection

Patients eligible for the study were male patients, completely edentulous for at least one year and for no more than three years with age ranging between 52 to 67 years and for whom a decision had already been made to incorporate dental implants for the treatment of complete edentulism. Following Misch[22] rules of bone classification patients with bone density ranging from 850-1250 HU (D2) and bone height and width more than 10mm and 5mm respectively in the anterior region of the mandible (Division A) were included in the study. Exclusion criteria included severe maxillomandibular skeletal discrepancy, clenching habits, bruxism, tempromandibular joint disorders, smokers, drug abuse, history of head and neck radiation and systemic disorders that may prevent surgery, affect bone quality or contribute to bone resorption.[23] Following this criteria twelve qualified patients were chosen and motivated to the treatment.

Prosthetic Procedures

Complete dentures were fabricated for all patients prior to implant installation to assure ideal implant placement in harmony with osseous anatomy, denture esthetics and abutment connection. For each patient upper and lower primary impressions were taken using alginate (Alginmax, Major Prodotti. Dentari SPA. Moncalieri. Italy) in stock trays and upper and lower secondary impressions were taken using medium body rubber base (Swiss TEC, Coltene, Whaledent, Altstatten, Switzerland) in specially constructed special trays. Occlusion blocks were fabricated on the poured master casts. Centric occluding relation was recorded following the conventional wax wafer technique. Casts were mounted on semi-adjustable articulator (Dentatus type ARH, AB Dentatus, Stockholm, Sweden). Setting up of teeth was done according to modified lingualized occlusion using modified cuspless teeth (Vita-pan acrylic teeth, Vita Bad Sackingen-Germany).[23] Waxed up denture was tried in the patient's mouth, then flasked and processed into high impact heat cure acrylic resin (Lucitone 199, Dentsply, York, PA-USA). Laboratory remounting was done before finishing the denture and occlusal discrepancies were adjusted.

Any necessary adjustments were carried out to eliminate occlusal interference and the denture was delivered to the patient. It was checked after twenty four and seventy two hours for any needed adjustment and to ensure that the patient was satisfied with esthetics, stability and retention of the denture. Following denture placement and patient adaptation, the mandibular denture was duplicated in clear acrylic resin(Vertex Rapid Simplified; Vertex-Dental BV, Zeist, The Netherlands) to act as a surgical guide for implant positioning to assure proper implants installation beneath the planned position which was determined by ideal denture contour and esthetics.

Surgical Procedures

For each patient two implants (Legacy I Implant Direct LLC, USA, Canada) with dimensions (3.7 x 13mm) were inserted bilaterally in the canine region at equal distance from the mid line, parallel to each other and perpendicular to the occlusal plane. All implants were placed by the same oral surgeon using surgical guide and following two stage surgical protocol. Covering screws were threaded into the implants which were left to heal for four months.

During the initial healing period (two weeks after surgery) no prosthesis was used over the implants so that early healing can occur without functional loading. After the two weeks period the tissue surface of the existing denture was relieved in the area overlying the installed implants. Resilient relining material (Permsoft Myerson Chicago IL. USA) was placed into the relieved areas to assure intimate tissue contact. All implants were allowed to integrate for four months. Osseointegration of the implants was verified by digital panoramic radiographs.

Following four months healing period patients were randomly divided into two equal groups according to the type of attachments they received.

Group-I: Received OT Equator Profile attachment (Rhein83 USA) in the form of:

Male part: Consisting of titanium + tin OT Equator Profile abutment of cuff height 2mm (Fig.1a). The male part was screwed onto the implant using hex screw driver, hexagon 1,3. Complete seating of the abutments on their corresponding implants was verified by radiographing the implant abutment interface.

Female part: Consisting of white cap of standard retention. Using retentive cap inserting tool, the cap was inserted into stainless steel cap's housing to be picked-up in the fitting surface of the denture (Fig.1b).

FIG. (1a) OT Equator abutment (male part)

FIG. (1b) OT Equator female cap

Group II: Received GPS attachment (Implant Direct LLC, USA, Canada) in the form of:

Female part

Consisting of metallic GPS abutment of cuff height 2mm (Fig.2a). The female part was screwed onto the implant using hex screw driver. Complete seating of the abutments on their corresponding implants was verified by radiographing the implant abutment interface.

Male part

Consisting of male clear cap of standard retention (4.5Ibs). Using male seating tool, the male cap was firmly pushed into the empty metal housing to be picked-up in the fitting surface of the denture (Fig.2b).

Pick-up Procedures

The mandibular overdenture base was relieved to accommodate the newly inserted attachments. The denture was tried in the patient's mouth to ensure complete seating. Any undercuts were blocked out using temporary filling (Litark, Lascod SpA-Vita L. Longo, Sesto F. no Firenze Italy). A mix of self cure acrylic resin (Lucitone 199; Dentsply) was applied in the relieved region for direct pick- up of the female part of OT Equator Profile attachment and male part of GPS attachment using close-mouth technique. Necessary adjustments were carried out to eliminate occlusal interference and the denture was delivered to the patient and checked after 24 and 72 hrs for any needed adjustment and to ensure that the patient was satisfied with esthetic, stability and retention of the denture.

FIG. (2a) GPS abutment (female part)

FIG. (2b) GPS male cap

Follow-Up Evaluation Schedule

Evaluation was scheduled at the denture insertion, three, six and twelve months following denture insertion. At these intervals, patients return for assessment of implant, prosthesis' function and standardized evaluation of his oral health. Cone Beam Computed Tomography (CBCT) was used to identify peri-implant radiolucencies and bone level.

Radiographic evaluation using Cone Beam Computed Tomography (CBCT)

Images were acquired using the Scanora 3D Imaging system (Scanora 3D, Sorredex-Finland) (voxel size 133um-350 um). The patients were exposed in the sitting position and the mandibles were immobilized by means of a head band to position the head against the head rest and chin cup, with the midsagittal plane perpendicular to the horizontal plane using vertical and horizontal alignment beams as recommended by the manufacture.

The Scanora 3D was equipped with a receptor CMOS flat panel (pixel size 200 um) and a single 360 degrees scan that collected the projection data for reconstruction (reconstruction time 2 min.). The X-ray field size applied in the current study (field of view for mandible only) was 23.2 cm diameter × 17 cm height, scanning time was 10-20 seconds and the effective exposure time was 2-5 seconds (fast enough to avoid patient movement, image blurring and haziness). The x-ray generator was a tube (fixed anode tube) of focal spot 0.5 mm IEC 336, target angle 5 degrees. Operating parameters were 80 kVp and 8 mA.

The Scanora 3D Imaging System software was used which allows the recording of linear bone height of images. The personal computer utilized was an Intel Core Duo- 2.13 Mhz-3.25 Gbites-21 inches flat screen 9 Hewlett-Packard Pavilion Elite m9200t series (Hewlett-Packard Pavilion Elite m9200t series USA).

The procedure was repeated for each patient to monitor the changes in bone height for each implant and in bone height at distal aspect of the ridge.

Image Analysis

Linear measurements for evaluation of crestal bone height

Mesial and distal crestal bone levels were calculated from the reconstructed panoramic views by drawing a line parallel to the implant serration extending from the crestal bone to the apical end of the implant (Fig.3a). Similarly, buccal and lingual bone levels were calculated by using the cross-sectional views (Fig.3b). Average readings of the four surfaces at each interval were calculated and tabulated for statistical analysis.

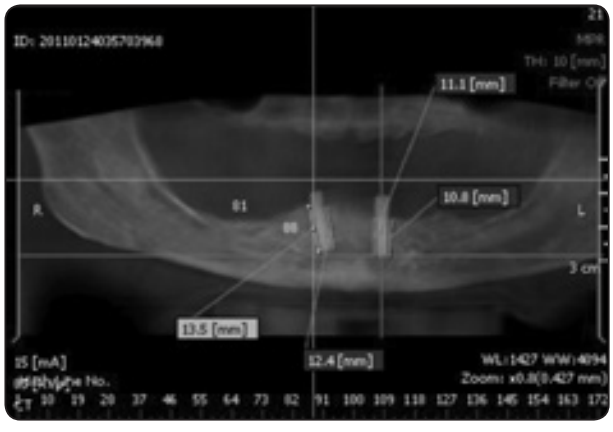

FIG. (3a) Panoramic view for mesial and distal crestal bone height

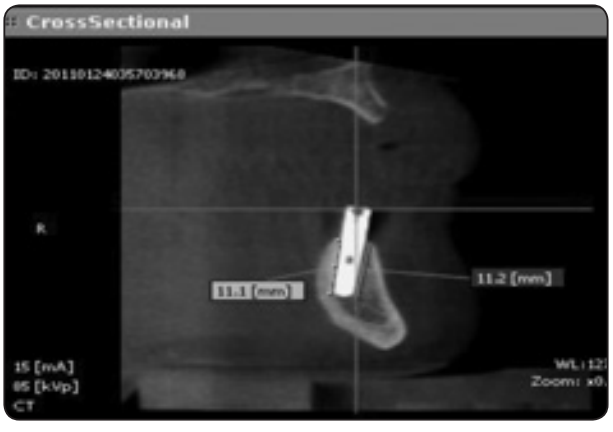

FIG. (3b) Cross-sectional view for buccal and lingual crestal bone height

Linear measurements for evaluation of bone height in distal aspect of the ridge

A cut was taken 1cm distal to the mental foramen (molar area) in each side of distal aspect of the ridge. Then, a tangent was drawn parallel to the horizontal plane at the intersection with the highest point of the ridge. Another tangent was drawn at the intersection with the lowest point of the ridge parallel to the horizontal plane and to the first tangent. A perpendicular line was drawn joining the two tangents to measure the bone height in the distal aspect of the ridge (Fig. 4). The readings at each interval were tabulated for statistical analysis.

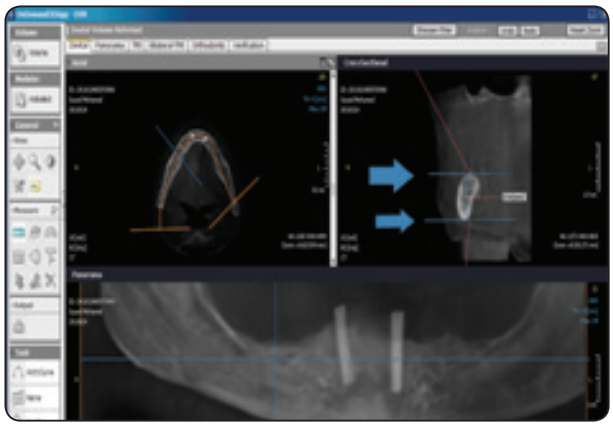

FIG. (4) Measuring bone height in distal aspect of the ridge

Statistical analysis

The statistical analysis of data was done by using excel program and SPSS program (statistical package for social science) version 16 on windows xp. Mean ± SD for normally distributed quantitative data was performed.

The analysis of data was done to test statistical significant difference between groups for quantitative data normally distributed (mean ± SD)

Paired and unpaired student t-test was used to compare the two studied groups.

P value is significant if ≤ 0.0 5 at confidence interval of 95%

RESULTS

Crestal bone height

There was decrease in mean value of crestal bone height surrounding the implants throughout the study period in both groups as shown in Fig. 5. By comparing this decrease student-t-test showed that there was statistically highly significant difference between the two studied groups where the OT Equator Profile attachment (Group I) showed more crestal bone height reduction than the GPS attachment (Group II) through all intervals of follow-up period as shown in table I and Fig.6.

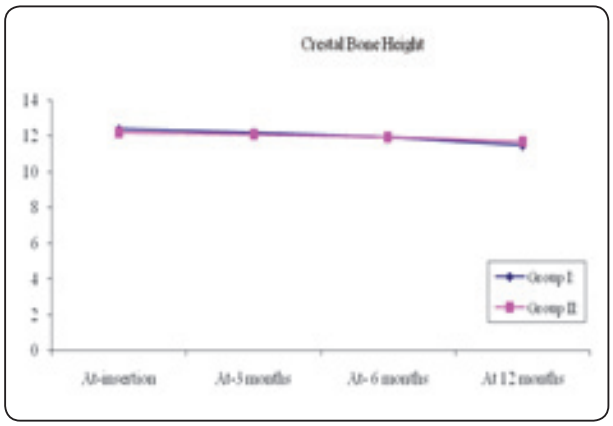

FIG. (5)Mean value of crestal bone height in the two studied groups

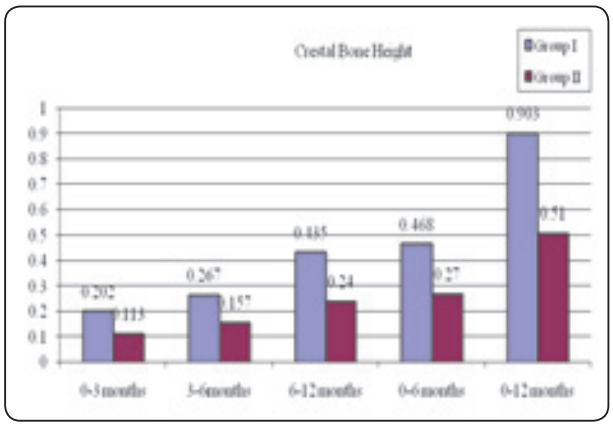

FIG. (6) Comparison between mean difference of crestal bone height in the two studied groups

TABLE (I) Comparison between mean difference of crestal bone height surrounding the implants in both studied groups at different intervals of follow-up period.

	Group I: OT Equator Profile attachment		***Group II: GPS attachment***		***Unpaired t-test***	***p-value***
Period	***Mean difference (mm)***	***SD***	***Mean difference (mm)***	***SD***		
0-3 months	**0.202**	**0.029**	**0.113**	**0.033**	**4.93**	0.000633**
3-6months	**0.267**	**0.050**	**0.157**	**0.033**	**4.51**	0.001588**
6-12 months	**0.435**	**0.071**	**0.240**	**0.061**	**5.13**	0.000477**
0-6 months	**0.468**	**0.077**	**0.270**	**0.047**	**5.37**	0.000604**
0-12 months	**0.903**	**0.056**	**0.510**	**0.030**	**15.26**	0.000001**

** p value < 0.05: significant. ** p value < 0.01: highly significant. ns= P value >0.05: non-significant*

Bone height at distal aspect of the ridge

There was slight decrease in mean value of bone height at distal aspect of the ridge throughout the study period in both groups as shown in Fig. 7. By comparing this decrease student-t-test showed that there was no statistically significant difference between the two studied groups through all intervals of follow-up period as shown in table II and Fig. 8.

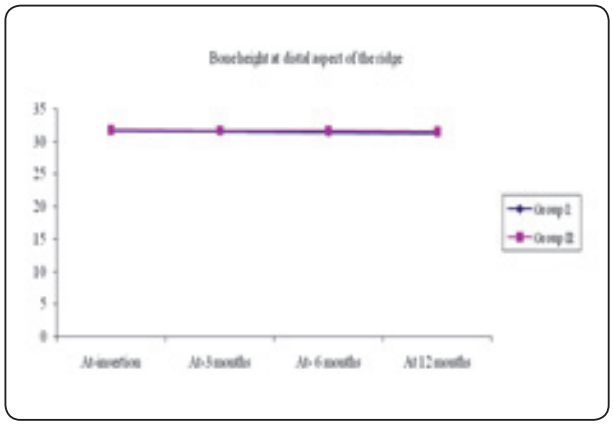

FIG. (7) Mean value of bone height at distal aspect of the ridge in the two studied groups

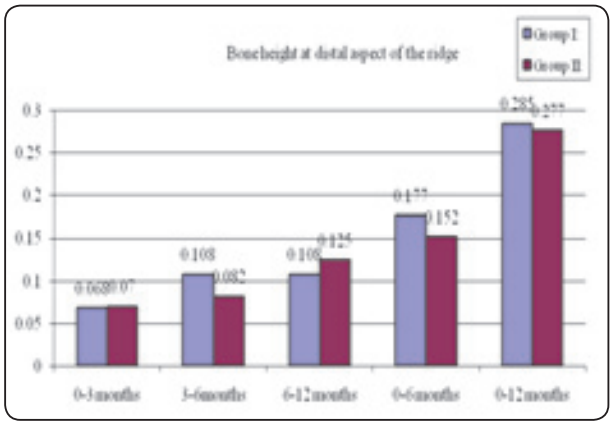

FIG. (8) Comparison between mean difference of bone height at distal aspect of the ridge in the two studied groups

TABLE (II) Comparison between mean difference of bone height at distal aspect of the ridge in both studied groups at different intervals of follow-up period.

	Group I: OT Equator Profile attachment		***Group II: GPS attachment***		***Unpaired t-test***	***p-value***
Period	***Mean difference (mm)***	***SD***	***Mean difference (mm)***	***SD***		
0-3 months	0.068	0.013	0.070	0.024	0.146	0.887293
3-6months	0.108	0.012	0.082	0.046	1.382	0.219076
6-12 months	0.108	0.010	0.125	0.033	1.175	0.285395
0-6 months	0.177	0.008	0.152	0.035	1.709	0.142273
0-12 months	0.285	0.005	0.277	0.014	1.387	0.210765

** p value < 0.05: significant. ** p value < 0.01: highly significant. ns= P value >0.05: non-significant*

DISCUSSION

The crestal bone loss values at the end of one year follow-up were 0.9 mm and 0.5 mm for OT Equator Profile and GPS attachments respectively. These results are within the acceptable range of implant success which has shown a mean marginal bone loss around dental implants of 1.5-2 mm in the first year after prosthetic restoration and 0.1-0.2 mm annually after that.[24,25] This also agrees with the findings of Cox and Zarb [26] who stated that mean crestal bone loss reaching 1.6 mm is accepted as a radiographic sign for implant success during the first year of implant loading. This bone reduction might be due to surgical trauma, bone osteotomy and healing process. Also it might be considered an immediate bone reaction after insertion of the prosthesis and the functional stresses following prosthesis connection. [27, 28]

Statistically significant difference in crestal bone height reduction occurred between the two groups in favor of the GPS attachment which showed less crestal bone resorption. This might be due to the difference in the abutment form in the two groups. In case of OT Equator Profile attachment the abutment connected to the implant is the male part which forms lever arm of 2mm cuff height while in case of GPS attachment the abutment connected to the implant is the female part which transfers the fulcrum point close to the fixture thus reducing lever arm and torque and allowing less crestal bone resorption.[29]

The decrease in bone height at distal aspect of the ridge was minimal and limited to 0.285 mm with OT Equator Profile attachment and 0.277mm with GPS attachment after one year follow-up period. This supported the findings of Meijer et al., [30] who found that placing two implants in the interforaminal region allows primary stability of the denture, thus eliminating the unwanted lateral forces and decreasing the residual alveolar ridge resorption. The insignificant difference between the two groups in bone height reduction at distal aspect of the ridge could be explained by the wide and proper distribution of load falling on the residual alveolar ridge in both groups. This was carried out by proper fit and maximum coverage of the edentulous ridge, together with proper adjustment of occlusion. [23]

CONCLUSION

Within the limitations of this study it can be concluded that:

GPS is less destructive to crestal bone around implants however, there is no difference between using OT Equator Profile attachment or GPS attachment on bone height at distal aspect of the ridge.

REFERENCES

1- Boerrigter EM, Stegenga B, Raghoebar GM, Boering G. Patient satisfaction and chewing ability with implant-retained mandibular overdentures: a comparison with new complete dentures with or without preprosthetic surgery. J Oral Maxillofac Surg 1995;53:1167-1173.

2- Meijer HJ, Raghoebar GM, Van't Hof MA, Geertman ME, Van Oort RP. Implant-retained mandibular overdentures compared with complete dentures; a 5-years' follow-up study of clinical aspects and patient satisfaction. Clin Oral Implants 1999; 10:238-244.

3- Naert I, Gizani S, Vuylsteke M, Van Steenberghe D. A 5-year prospective randomized clinical trial on the influence of splinted and unsplinted oral implants retaining a mandibular overdenture: prosthetic aspects and patient satisfaction. J Oral Rehabil 1999;26:195-202.

4- Awad MA, Locker D, Korner-Bitensky N, Feine JS. Measuring the effect of intra-oral implant rehabilitation on health-related quality of life in a randomized controlled clinical trial. J Dent Res 2000; 79:1659-1663.

5- Awad MA, Lund JP, Shapiro SH, Locker D, Klemetti E, Chehade A, et al. Oral health status and treatment satisfaction with mandibular implant overdentures and conventional dentures: a randomized clinical trial in a senior population. Int J Prosthodont 2003; 16:390-396.

6- Heydecke G, Locker D, Awad MA, Lund JP, Feine JS. Oral and general health related quality of life with conventional and implant dentures. Community Dent Oral Epidemiol 2003;31:161-168.

7- Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Gerodontology 2002;19:3-4.

8- Naert I, Quirynen M, Theuniers G, van Steenberghe D. Prosthetic aspects of osseointegrated fixtures supporting overdentures. A 4-year report. J Prosthet Dent 1991;65:671-80.

9- Phillips K, Wong KM. Space requirements for implant-retained bar-and-clip overdentures. Compend Contin Educ Dent 2001;22:516-22.

10- Preiskel HW. Stud attachments and magnets. In: Overdentures made easy: A guide to implant and root supported prostheses. London: Quintessence 1996: 89-97.

11- Pasciuta M, Grossmann Y, Finger I. A Prosthetic solution to restoring the edenulous mandible with limited interarch space using an implant tissue supported overdenture: A clinical report. J Prosthet Dent 2005; 93:116-20.

12- Wittwer G, Adeyemo WL, Wagner A, Enislidis G. Computer-guided flapless placement and immediate loading of four conical screw-type implants in the edentulous mandible. Clin Oral Implants Res 2007; 18: 534-539.

13- Ganz SD: Conventional CT and cone beam CT for improved dental diagnostics and implant planning. Dent Implantol Update 2005; 16:89-95.

14- Rossi R, Morales RS, Frascaria M, Benzi R, Squadrito N. Planning implants in the esthetic zone using a new implant 3D navigation system. Eur J Esthet Dent 2010; 5: 172-188.

15- Loubele M, Van Assche N, Carpentier K, Maes F, Jacobs R, van Steenberghe D. Suetens P. Comparative localized linear accuracy of small-field cone-beam CT and multislice CT for alveolar bone measurements. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:512-8.

16- Ludlow JB. Regarding 'Influence of CBCT exposure conditions on radiation dose. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics 2008 106: 627-628.

17- Viegas VN, Dutra V, Pagnoncelli RM, de Oliveira MG. Transference of virtual planning and planning over biomedical prototypes for dental implant placement using guided surgery. Clinical Oral Implants Research 2010; 21: 290-295.

18- Sukovic P. Cone beam computed tomography in craniofacial imaging. Orthod Craniofac Res 2003; 6:31-36.

19- Ziegler CM, Woertche R, Brief J, Hassfeld S. Clinical indications for digital volume tomography in oral and maxillofacial surgery. Dentomaxillofac Radiol 2002; 31:126–30.

20- De Vos W, Casselman J, Swennen GR. Cone-beam computerized tomography (CBCT) imaging of the oral and maxillofacial region: A systemic view of the literature. Int J Oral Maxillofac Surg 2009;38:609-625.

21- Spector L. Computer-aided dental implant planning. Dental Clinics of North America 2008; 52:761-75.

22- Mish,C. 11. Classification of partially and completely edentulous arches in implant dentistry In: Contemporary implant dentistry. St. Louis. C.V. Mosby, 1993; 201-221.

23- Mish,C. Maxillary denture opposing an implant prosthesis: Hydroxyapatite augmentation and modified occlusal concepts. In: Contemporary implant dentistry. St.Louis.C.V.Mosby, 1999; 629-746.

24- Ibrahim AM. Influence of platform switching on crestal bone changes at non-submerged straight and inclined implants retaining mandibular overdentures. Cairo Dental J 2009; 205-217.

25- Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JYK. Clinical complications with implants and implant prostheses. J Prosthet Dent 2003; 90:121-132.

26- Cox J, Zarb G. The longitudinal clinical efficiency of osseointegrated dental implants. A 3-years report. Int. J. Oral Maxillofac. Implants, 1987, 2: 91-100.

27- Hohlweg MC, Metzger b T, Kummerc D, Schulze B. Hohlweg- Majert B. Article in press as: Hohlweg-Majert B et al., Morphometric analysis- Cone beam computed tomography to predict bone quality and quantity, Journal of Cranio-Maxillo-Facial Surgery 2010, 10:1016.

28- Jonkman RE, Van Waas MA, Plooij J, Kalk W. Measuring mandibular ridge reduction on oblique cephalometric radiographs. J Craniomaxillofac Surg. 1991;19: 27-30.

29- Jingade RK, Rudraprasad IV, Sangur R. Biomechanics of dental implants: A FEM study. J. Indian Prosthodont.Soc. 2005; 5:18-22.

30- Meijer H, Starmans F, Steen W, Bosman F. A three-dimensional finite element study on two versus four implants in an edentulous mandible. Int. J. Prosthodont., 1994; 7: 271.