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Evaluation Of Crestal Bone Loss Around Two Different Implant Systems Supporting A Mandibular Overdenture - A Clinical Study

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Abstract

Background: Problems associated with complete denture such as lack of stability and retention can be solved with the use of implant supported overdentures. The aim of this study was to compare crestal bone loss around two different dental implants supporting a mandibular overdenture following one stage surgical procedure and early loading protocol .

Materials and Methods: Ten healthy edentulous patients were selected, in whom two different endosseous implants with O - ring encapsulated in the metal housing (Myriad, Equinox, Netherlands) and O - ring not encapsulated in the housing (TRX - BA, Hi- Tec, Israel) were placed in the interforaminal region of the mandibular arch and loaded with implant supported overdentures using ball attachment, where one stage surgical procedure and early loading protocol were followed. Evaluation of crestal bone loss around the two implants was carried out at baseline , 3, 6 , 9 and 12 months interval .

Results: The data obtained was statistically analysed using unpaired T test and no significant crestal bone loss was noticed between the implant systems. (P value > 0.05) .

Conclusion: Within the limitations of the study, early loading of two different implants supporting a mandibular overdenture is possible and there was no significant difference in marginal bone loss around implant retaining mandibular overdenture relative to implant type or attachment designs.

Key Words
Crestal bone loss; Early loading; Mandibular implant overdenture; One- stage surgery.

Introduction :

The edentulous patient presents a treatment challenge to each dental practitioner that has often been resolved inadequately. The primary complaints about the removable denture are retention, stability, decreased chewing ability; especially in severely resorbed mandibular ridges.[1] This is due to continuous alveolar ridge resorption following tooth extractionand conventional dentures rely on the residual alveolar ridge for support and retention. Many treatment modalities like denture base extension, ridge grafting, alveoplasty, vestibuloplasty have been tested to solve this problem with limited success. However, tooth supported or implant supported overdentures are successful in overcoming this problem to a greater extent.

Dental implant treatment has revolutionized oral rehabilitation in partially and fully edentulous patients. With the introduction of osseointegration concept in 1977 by Per Ingvar Branemark, it became possible to achieve high success rates with this treatment modality, and multiple investigations have demonstrated an excellent long-term prognosis.[2] The concept of implant supported overdenture has been used for many years and successful reports were published with mandibular subperiosteal implants or with immediately loaded implants.[3]

Different protocols have been described in the literature for surgical placement and prosthetic loading of implants.[4] These can be either one stage or two stage procedure. Turkyilmaz,[5] Roe,[6] Payne,[7] Wolfinger[8] identified successful immediate and early loading of mandibular implant overdentures over delayed loading. The acknowledged advantages with this one stage procedure, which includes reduction in the number of surgical procedures, healing periods and the total treatment cost.[9]

Alberkston et al [10] proposed criteria for an implant to be considered successful. The success of implant is based on the factors like absence of mobility, amount of bone loss ,presence of any signs and symptoms of pain and infection. He stated that annual bone loss around the implant should be less than 1mm after one year of implant function and mean annual bone loss should not exceed 0.2 mm. The goal of this prospective clinical study was to evaluate the crestal bone loss of two different dental implants - with and without O - ring encapsulated in metal housing, supporting a mandibular overdentures using a one stage procedure and early loading protocol.

Materials and Methods :

Ten completely edentulous patients attending the department were selected for the study.**(Figure.1)** Informed consent from the patient and institutional ethical clearance was obtained priorly. The inclusion criteria were patients within the age group of 40-65 years,

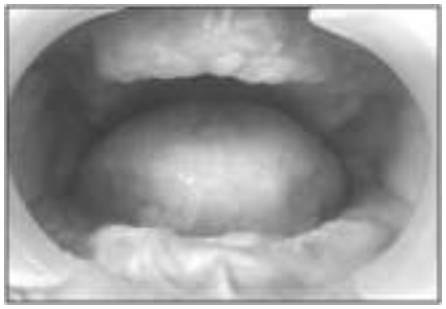

Figure 1 - Completely Edentulous Arches.

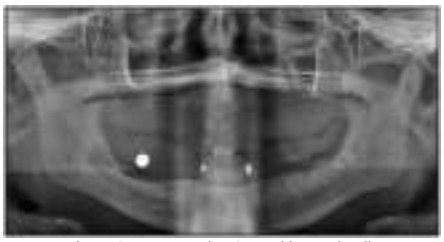

Figure 2 - Preoperative Opg With Metal Ball.

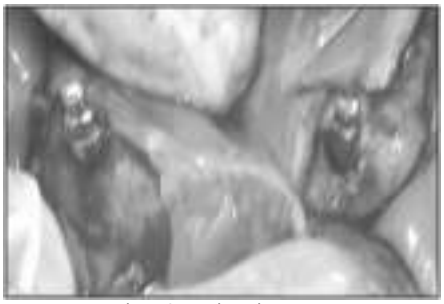

Figure 3 - Implant Placement.

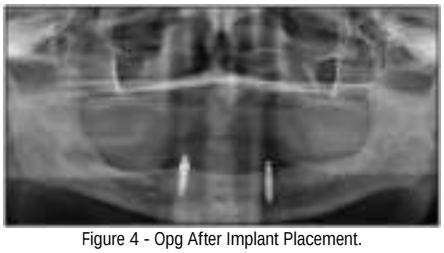

Figure 4 - Opg After Implant Placement.

absence of any systemic diseases; minimum of two year period of edentulism; adequate interarch space of 16 - 22 mm and residual bone height of 10 - 15 mm in anterior mandible region. Patients who were medically compromised, heavy smokers and patients who have undergone bone grafting in anterior mandible and previously irradiated jaws were excluded.

Prior to implant surgery, standardized prosthodontic procedures were followed to fabricate new complete maxillary and mandibular dentures for all the patients. Preoperative panoramic radiographs **(Figure.2)** ;(Orthophos XG, Sirona dental company, Germany) were used for evaluation of available bone height for implant placement in the anterior mandible. Intraoral periapical radiographs (IOPR) were preferred over OPG due to its high resolution and accuracy. Standardised IOPR were taken using a paralleling technique with the help of a Rinn XCP holders and photostimulated phosphor plate receptor.[11] To determine the accuracy of image , metal ball of known dimension was placed at the implant site and radiograph was taken. The diameter of the metal ball was measured on the radiograph and amount of magnification was calculated. Linear distance measurements were made from first bone to implant contact to the implant apex on the mesial and distal sides of the implant. Data were analysed using DIGORA software(Soredex, Germany) and the same procedure was carried out during follow up.[12]

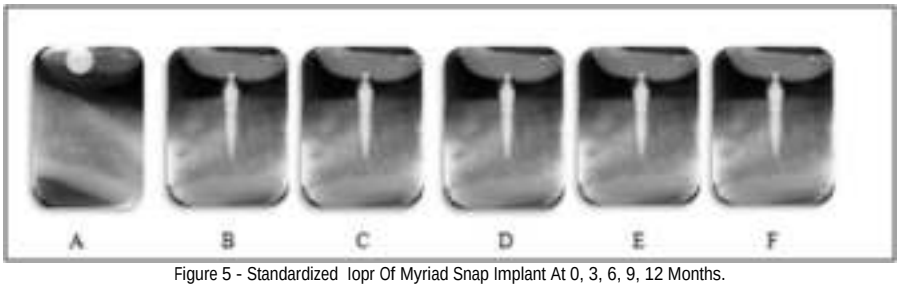

Figure 5 - Standardized Iopr Of Myriad Snap Implant At 0, 3, 6, 9, 12 Months.

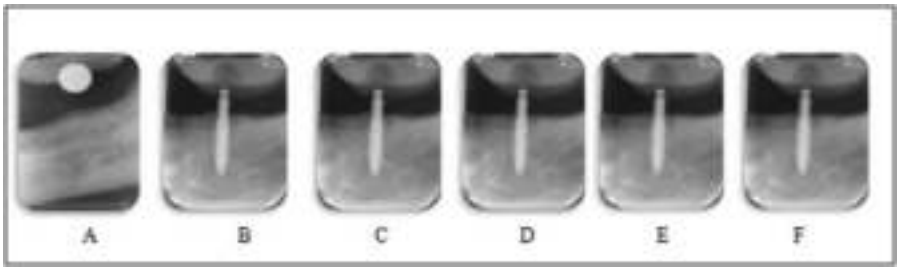

Figure 6 - Standardized Iopr Of Trx-ba Implant At 0, 3, 6, 9, 12 Months.

A standardised length of 13 mm implant was selected in both the implant systems . Myriad snap implant (Myriad, Equinox, Netherlands) of diameters 2.5 , 3.3 mm were placed in the right side of the mandible and TRX - BA implant (TRX - BA, Hi -Tec, Israel) of diameters 2.8 , 3.3 mm were placed in the left side of mandible depending on available bone.

Surgical and Prosthodontic procedures:

Prophylactic antibiotic coverage (Amoxycillin) was given orally 1 hour before each surgery. Patient was instructed to rinse the mouth with 0.2% chlorhexidine solution for 1 minute, prior to commencement of the procedure. All the surgical procedures were carried under strict aseptic condition. Surgical area was anesthesized with local anesthesia (2% lignocaine with adrenaline 1:80.000) and surgical access to the mandible was gained through a mid crestal incision over the keratinised gingiva with a No.15 B.P. blade. Full thickness flap was elevated using periosteal elevator and osteotomy was carried out according to the manufacturer's instructions. Once the osteotomy site was prepared, implants of selected dimension were placed **(Figure.3)**. During the drilling process, care was taken for maintenance of parallelism between implants. The flap was closed with 3 -0 silk sutures to achieve primary closure. OPG was taken immediately after surgery to evaluate the placement of implants radiographically **(Figure.4)**.

Post surgically, patients were advised to use antibiotics and analgesics for 5 days. After one week, sutures were removed and patients were advised not to use mandibular denture for the first two weeks. Following wound healing, the impression surface of the denture at sites corresponding to the implant were relieved. The O-ring attachment assembly was placed over the two implants, undercuts blocked out and autopolymerizing resin was used for direct pickup.[13] The dentures were finished, polished and occlusion was adjusted accordingly.

Follow - up:

Post operatively, all the implants in the study group were evaluated clinically and radiographically at baseline, 3, 6, 9 and 12 months interval **(Figures 5, 6)** and data was analysed using DIGORA

Table 1 - Marginal Bone Loss Around Two Implants.

Time	Left(Mesial + distal)		Right (Mesial + distal)		Difference	P Value
	Mean	Sd	Mean	Sd	Mean ± sd	
Baseline	14.26	0.39	13.72	0.40	0.54 ± 0.01	0.066 Ns
3 Months	13.98	0.59	13.56	0.49	0.42 ± 0.10	0.254 Ns
6 Months	13.83	0.59	13.43	0.53	0.40 ± 0.06	0.296 Ns
9 Months	13.66	0.57	13.26	0.57	0.40 ± 0.00	0.309 Ns
12 Months	13.54	0.52	13.12	0.47	0.42 ± 0.05	0.291 Ns

Statistical Analysis: Unpaired T Test. Statistically Significant If P < 0.05

software.

Results :

Marginal bone levels were computed mesially and distally for each implant from the reference point , enabling calculation of marginal bone loss between 2 weeks and 48 weeks . Difference at baseline and follow up scores were tested for significance using unpaired ' T ' test. The mean value of left side implant was 14.26 at baseline and 13.54 at the end of one year ; the mean value of right side implant was 13.72 and 13.12 respectively, with P value ranging from 0.066 at baseline and 0.291 at the end of one year. From the above statistical analysis , there was no significant difference in marginal bone loss between the two different implants supporting a mandibular overdenture in all the subjects (P > 0.05). **(Table 1)**

Discussion :

The prosthetic management of the edentulous patient has long been a major challenge for dentistry. For well over a century, complete maxillary and mandibular dentures have been the traditional standard of care. However, most patients reported problems in adapting to their mandibular denture due to a lack of retention, stability and inability to chew. Recent scientific studies carried out over the past decade have determined that the benefits of a mandibular two-implant overdenture are sufficient to propose the two implant overdenture rather than the conventional denture as the first treatment option.[14] This trend in the prosthodontic literature has led to a significant shift in therapeutic philosophy regarding restoration of the edentulous patient. The McGill Consensus Statement indicates that as a minimal treatment objective, the mandibular two-implant overdenture should be considered as a first-choice standard of care for the edentulous patient.[15]

The two stage surgical protocol established by Branemark recommends a waiting period of 3 to 6 months. Since last 15 yearsseveral authors like Tallarico[16] and his colleagues have questioned the standard 'two stage protocol' by Branemark and were of the opinion that one stage protocol with immediate loading is equally effective as two stage protocol.

Various endosseous implant systems have been introduced over the years to equip clinicians to restore partially and fully edentulous jaws. The major differences among the various implants are found in their design, single stage or two stage and their surface modifications.Various coatings like calcium phosphate, hydroxyapetite, bioactive glass coatings have been developed to improve the ability of implant to bond to living tissues, particularly the bone.

Literature review showed comparison between two different implant systems in the same patient. However studies regarding the use of two different implant systems supporting a mandibular overdenture in the same patient were at sparse.[17],[18]. As two individuals differ in their systemic and functional conditions , we compared two different implant systems in the same patient for better standardization under similar conditions to assess their function and longevity.

The two systems used in the study are Myriad implant system from Equinox medical technologies, Netherlands and Hi-Tec implant system, Israel.

The MYRIAD SNAP implant , from the Myriad implant system is based on the Anaform root shaped, tapered body design which is the most proven and versatile shape for immediate and delayed implantation. The Bioprofile thread featured on all Myriad implants is an asymmetrical surface extensive thread. Bioprofile essentially comprises one synchronized self tapping thread composed of three distinct thread profiles that are adapted to three different levels of bone biology. All Myriad implants carry the unique Nanopore titanium anodic oxidation surface. This calcium oxidized nanosurface results in 11% calcium deposits saturating the implant surface. O - ring from this implant system is encapsulated in a metal housing. Such metal encapsulator permits easy replacement of O - ring if any damage occurs. This also eliminates need for chairside reline procedure for incorporating new attachment.

TRX-BA implant from Hi - Tec implant system is a one-piece immediate loading implant with the built on overdenture abutment and has unique high initial stability requiring minimal drilling. It also has integrated surface, macro & micro roughened surface enhances bone stimulation and increases load-bearing capacity that increases bone attachment in poor bone quality and shortens time from surgery to loading.It also has polished integrated trans-gingival section which promotes instant post-operative healing of the soft-tissue and minimizes crestal bone loss. O - ring from this implant system is not encapsulated in any metal housing.

Although CT is more precise in measuring bone loss, the method of choice for radiographic evaluation of bone loss in several multicenter studies is intraoral periapical radiography due to its simplicity and feasibility.[11] When an implant is osseointegrated, marginal bone loss is reduced to levels that one expects to find around healthy teeth. The bone loss levels compared with an edentulous jaw are dramatically improved, which is a major factor in considering implant placement today. Misch[1] claimed that the stresses at the crestal bone may cause microfracture or overload, resulting in early crestal bone loss during the first year of function, and the change in bone strength from loading and mineralisation after one year alters the stress-strain relationship and reduces the risk of microfracture during the following years. When an implant is osseointegrated, marginal bone loss is reduced to levels that one expects to find around healthy teeth. The bone loss levels compared with an edentulous jaw are dramatically improved, which is a major factor in considering implant placement today. Misch[2] claimed that the stresses at the crestal bone may cause micofracture or overload, resulting in early crestal bone loss during the first year of function, and the change in bone strength from loading and mineralisation after one year alters the stress-strain relationship and reduces the risk of microfracture during the following years. In longitudinal studies, Atwood[19] and Tallgren[20] showed an average annual alveolar ridge height reduction of approximately 0.4 mm in the edentulous anterior mandible resulting from physiologic changes.

Smith AT et al conducted a study to evaluate feasibility and success of two different implant systems (Steri- Oss , Nobel Biocare, Gotenborg , Sweden and

Southern implants Irene ,South Africa) using a one stage procedure in patients rehabilitated with implant supported mandibular overdentures and observed no statistically significant differences in marginal bone loss ($P > 0.05$). [17]

Payne A et al in their one year study evaluated marginal bone loss in early loaded unsplinted implants supporting mandibular overdentures and observed no significant difference in mean marginal bone loss levels ($P > 0.05$). [7]

The results of the study are in accordance with the systematic review and meta-analysis conducted by Cehreli et al[21] who had identified that there was no difference in marginal bone loss around implants retaining / supporting mandibular overdentures relative to implant type or attachment designs when a total of 4,200 implants from 13 manufacturers were assessed. Prospective reports on larger group of patients and long term evaluation would be necessary to further evaluate the validity of this overdenture concept. Crestal bone loss around two implant systems were considered in the present study and the results may vary with other implant designs and systems.

Conclusion :

- This study identifies successful early loading of two different implant systems (Myriad and Hi Tec) supporting a mandibular implant overdenture.
- There was no significant difference in marginal bone loss around implant retaining mandibular overdenture relative to implant type or attachment designs.

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