RESEARCH ARTICLE

A COMPARATIVE EVALUATION OF CRESTAL BONE LEVEL AROUND CONVENTIONAL PROSTHESIS IMPLANTS VERSUS ALL-ON-4® PROSTHESIS IMPLANTS- TWO YEAR FOLLOW UP STUDY

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ABSTRACT

Aim: The aim of the study was to evaluate the difference in marginal bone loss levels for full arch implants placed axially in comparison to All-on-4® concept.

Material and Method: Ten systemically healthy full arch edentulous patients were divided into 2 groups based on treatment to be provided. In Group 1, six or more implants were placed axially and second group was rehabilitated using minimum of four implants by All-on-4® concept. Final restoration was delivered after 3 and 6 months in mandible and maxilla respectively. Crestal bone levels were measured and compared in both groups using digital vernier calliper after 1 and 2 years

Results: Statistical analysis showed greater mean distances between the implant shoulder and crestal bone levels in conventional delayed loading when compared to immediate loading in All-on-4® concept, however the results were not significant.

Conclusion: Placement of well anchored angled posterior implants with anterior axially oriented implants provides a predictable foundation for implant-supported full arch prosthesis within the acceptable physiological limits of bone loss**.**

Keywords: Dental implants, All-on-4®, Crestal bone level, Axial implants, Tilted implants, Edentulous rehabilitation

INTRODUCTION

Dental implants are one of the most exciting treatment modality in modern dentistry with highly predictabe reported success rate of about 96.5%.[1] Implants have evolved as a technique of choice for full mouth rehabilitation of edentulous patients. The history of evolution of dental implants is very fascinating as it has travelled a long journey and emerged from "24-gauge hollow latticed cylinder of iridio-platinum soldered with 24-karat gold" artificial root placed by Dr. EJ Greenfield[2] in 1913 to modern surface treated root form titanium implants. There have been various modifications in techniques of placing implants.

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Traditionally dental implants were placed in the axial position. However, in completely edentulous jaws and post extraction patients, problems such as minimum bone volume and poor bone quality, create some challenging conditions. For such situations, it has been demonstrated that distal tilting of implants may be advantageous. Tilting preserves relevant anatomical structures and allows for placement of longer implants with good bi-cortical anchorage in optimal positions for prosthetic support.[3,4] This idea was used by Paulo Malo who developed the All-on-4® treatment concept with straight and angled multi-unit abutments for complete rehabilitation of full edentulous arch. Two implants are placed axially in the anterior region and two distally, tilted upto an angle of 45^{o} in the posterior region. In mandible, tilting of posterior implants makes it possible to achieve good bone anchorage without interfering with mental foramina. In severely resorbed maxillae, tilted implants are an alternative to sinus floor augmentation.[5] This concept has gained popularity as it obviates the need of additional advanced procedures like bone grafting, ridge augmentation, sinus lift and nerve repositioning. It also protects the nearby anatomic structures, enables immediate function and provides predictable results with extremely high patient satisfaction.

The longevity of dental implants is highly dependent on integration between implant components and oral tissue (hard and soft). Studies have shown that submerged titanium implants had 0.9 to 1.6 mm marginal bone loss from the first thread by the end of the first year in function, while only 0.05 to 0.13 mm bone loss occurred after the first year.[6] It has been proved that tilting of the implants does not induce significant alteration in crestal bone level change as compared to conventional axial placement after 1 year of function. The use of tilted implants to support fixed partial and full-arch prostheses for the rehabilitation of edentulous jaws can be considered a predictable technique, with an excellent prognosis in the short and mid-term. In this study, we evaluated the difference in marginal bone levels for patients being rehabilitated by implants placed axially in comparison to the tilted implants according to All-on-4® concept.

MATERIALS AND METHODS

Patient selection

Ten patients in need of complete rehabilitation of the edentulous maxilla/mandible were included in the study. Patients were divided into 2 groups where group 1 was rehabilitated using six or more implants axially in conventional

manner and group 2 with minimum of four implants, 2 anterior axially oriented and 2 posterior distally inclined in accordance with All-on-4® concept. Standardization of factors that can influence the results such as age range, bone quality, implant type, surgical technique and loading periods were achieved throughout the study. The opposing dentitions were either natural/ removable/ implant supported.

CLINICAL PROTOCOL

Presurgical preparation

Pre-operative orthopantogram were made to assess bone condition and available bone height. Study models prepared and mounted for ridge mapping, evaluation of interocclusal space and construction of a surgical stent. Before the surgical procedure, provisional dentures were made for group 2 patients. Oral prophylaxis appointments were scheduled and performed. All patients received 2 g Amoxicillin + Clavulanic acid (Glaxo SmithKline, England) 1 h before surgery (or an alternative for patients with allergy) and continued with 2 g/day for 5 days.

Surgical protocol

Full thickness mucoperiosteal flap was raised after appropriate anesthesia, Nobel Biocare surgical All-on-4® guide was used for All-on-4® patients. Sequential drilling to the desirable depth of the recipient bone under copious irrigation was done at the planned sites. Posterior implants (Nobel Replace® Select Tapered in group 1 and Nobel Active® Internal in Group 2), were inserted as posteriorly as possible to increase anteroposterior (AP) spread. Osteotomy sites were enlarged to receive appropriate dental implants of suitable platform diameter according to the preplanned preoperative workup. All implants were inserted at the bone level according to protocol and cortical stability of 35 N was achieved.

Patients were instructed to have a soft diet and avoid chewing in the treated area until the suture removal. Oral hygiene at the surgical site was limited to soft brushing for the first 2 weeks. Regular brushing in the rest of the mouth and rinse with 0.12% chlorhexidine were prescribed for 2 weeks. Sutures were removed after 1 week.

Pre-prosthetic procedure

Open tray impressions were made with wire and GC resin splint for improved accuracy. A provisional denture was prefabricated with heat-cured acrylic resin (Ivoclar high-impact acrylic, IvoclarVivadent, Schaan, Liechtenstein) prior to the surgical procedure.

Prosthetic procedures

Immediately following surgery, the denture was modified according to master model and fabrication was completed using cold-cure material (Probase, Ivoclar Vivadent). This provisional all-acrylic resin prosthesis was seated within 3 to

4 hours after surgery on the same day. The patients were scheduled for follow-up visits at 1, 2, 4 and 12 weeks postoperatively.

The oral hygiene status was evaluated at the follow-up intervals. Periapical radiographs, plaque and bleeding indices at various follow-up intervals were recorded as a part of routine care for patients.

Prosthesis Design

Milled titanium framework with a wrap-around heat-cured acrylic resin (Ivoclar high-impact acrylic) was decided to be used as final prosthesis.

Final restorations and follow ups

Definitive prosthesis was inserted after 3-6 months.

Radiographic Evaluation

Immediate post-operative and annual OPG's were evaluated for crestal bone level from the implant platform to the coronal most level of bone alongside the implant body using digital vernier calliper.

RESULTS:

Measurement from OPG revealed that mean crestal bone loss at 1 year is 0.912 mm and at 2 years 1.112 mm in conventional axially oriented implants. (Table 1) (Figure 1, Figure2)

Mean crestal bone loss in All-on-4® cases was 0.84 mm and 0.968 mm in axial implants and 0.916 mm and 1.08 mm in posterior tilted implants in 1 and 2 years respectively. (Table 2) (Figure 3, Figure 4)

On comparing the most posterior implants, it was found that mean crestal bone loss in conventional implants is almost similar to All on 4® cases (0.912mm compared to 0.916 mm) at 1 year and at 2 years (1.112 mm compared to 1.08 mm in All-on-4® cases) (Table 3) (Figure 5)Statistical analysis showed greater mean distances between the implant platform and crestal bone levels in conventional delayed loading in comparison to immediate loading All-on-4® concept however, the results were not significant.

DISCUSSION:

Placement of implant is to restore lost teeth and preserve alveolar bone. Edentulous full arch rehabilitation can be done either by using 6 or more axially placed implants in conventional manner or by utilising a newer concept of All-on-4® in which, 2 anterior implants are placed axially and posterior are placed at an angle to prevent encroachment of the maxillay sinus or inferior alveolar nerve.

Factors which affect the alveolar bone loss around implants include type of flap raised (Full thickness/partial thickness), factors related to osteotomy like heat generation and excessive pressure, parafunctional habits, hygiene maintenance, bacterial invasion and occlusal overload. Forces on

axial implants are favorable as they are directed vertically along the long axis of implant and distribute stress more evenly throughout the implant. But in case of angulated implants, forces are directed at an angle and thus are associated with higher forces acting on implant-bone interface during axial loading which should logically induce bone resorption by disrupting the implant-bone interface. But this hasn't been demonstrated in vivo. In contrast to expectations, in All-on-4® treatment modality, the crestal bone around angulated implant shows minimal resorption. In fact, it has been shown that tilting of posterior implants improves prosthesis support.[7]

We found lesser crestal bone loss in All-on-4® concept (0.84 mm in first year which increase to 0.968 mm in two years) compared to conventional axially oriented implants (0.912 mm in one year and 1.112 mm in two years). Various studies carried out regarding success rate of angulated implants, have shown same or less amount of crestal bone loss in comparison to axial implants.[8] Our results are consistent with findings of Agliardi et al (2010). They showed marginal bone loss levels of 0.8 mm for tilted implants and 0.9 mm for axial implants.[9] No significant difference in marginal bone loss was observed between axial and tilted implants. In one of the recent meta-analysis, it is concluded that tilted and axial implants are equally successful.[10]

One of the possible explanations for this may be the even distribution of forces in All-on-4® prosthesis, as all implants are splinted. De Souza Batista et al (2017) reported effectiveness of splinting associated with an offset implant configuration in decreasing the stress on abutment screws and microstrain on bone tissue. Anitua and Orive (2009) reported that offset implant placement apart from enabling an optimal aesthetic restoration, reduces bone stress compared with the straight configuration.[11] Shimura et al (2016) reported that offset placement may not necessarily be more biomechanically effective than straight placement in edentulous posterior mandibles.[12] Ata-Ali et al (2012) performed meta-analysis on oral rehabilitation with tilted implants and deduced that tilted implants exhibit same evaluative behavior as axial implant. The marginal bone loss observed with the tilted and axial implants likewise proved very similar.[10]

CONCLUSION

Placement of well anchored angled posterior implants with anterior axially oriented implants provides a predictable foundation for implant-supported full arch prosthesis within the acceptable physiological limits of bone loss.

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TABLES:

Table 1: Mean difference at different intervals in axially oriented implants

Time Interval	**Mean**	**SD**	**p- value**
1 year	0.918	0.043	0.000
2 years	1.08	0.077	

Table 2: Mean difference at different intervals using ALL-ON-4implants

Time Interval	**Mean**	**SD**	**p- value**
AXIAL 1 year	0.84	0.025	0.000
2 years	0.91	0.028	
CONVENTIONAL 1 year	1.01	0.011	0.000
2 years	1.21	0.28	

Table 3: Comparison of posterior most implants at different intervals in both concepts

Time interval	Mean	SD	p- Value
1 year Conventional	0.91	0.043	0.008
All-on-4	0.84	0.025	
2 years Conventional	1.08	0.077	0.000
All-on-4	0.91	0.028	

FIGURES:

Figure 1: OPG after 1 year

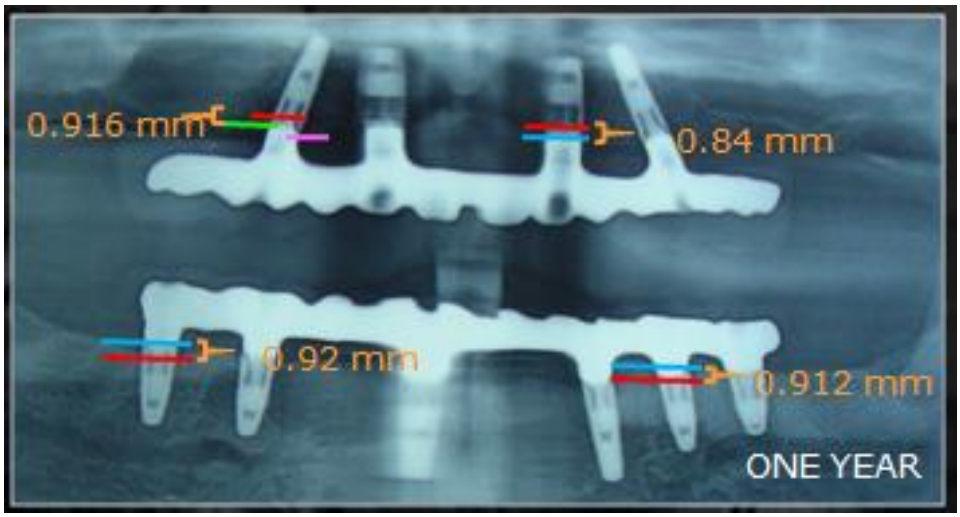

Figure 2: Mean difference at different intervals in axially oriented implants

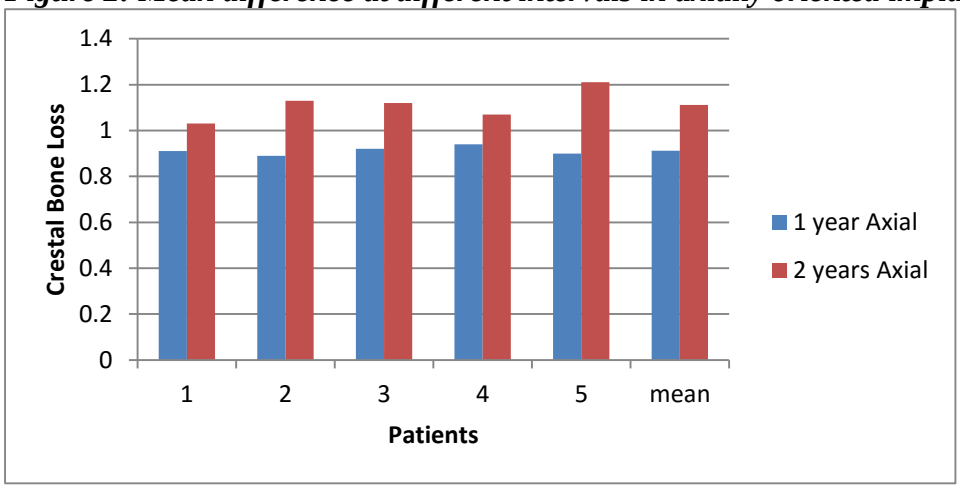

Figure 3: OPG after 2 years

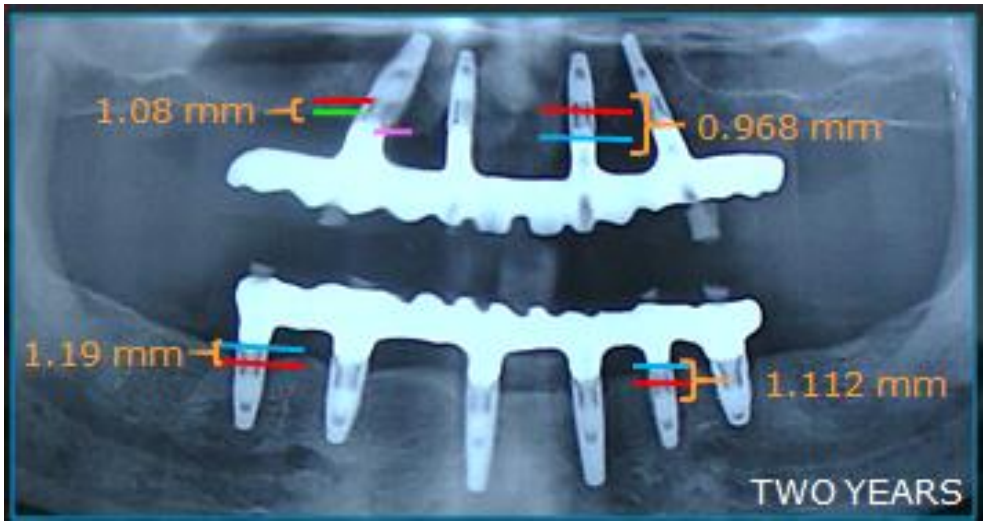

Figure 4: Mean difference at different intervals using ALL-ON-4 implants

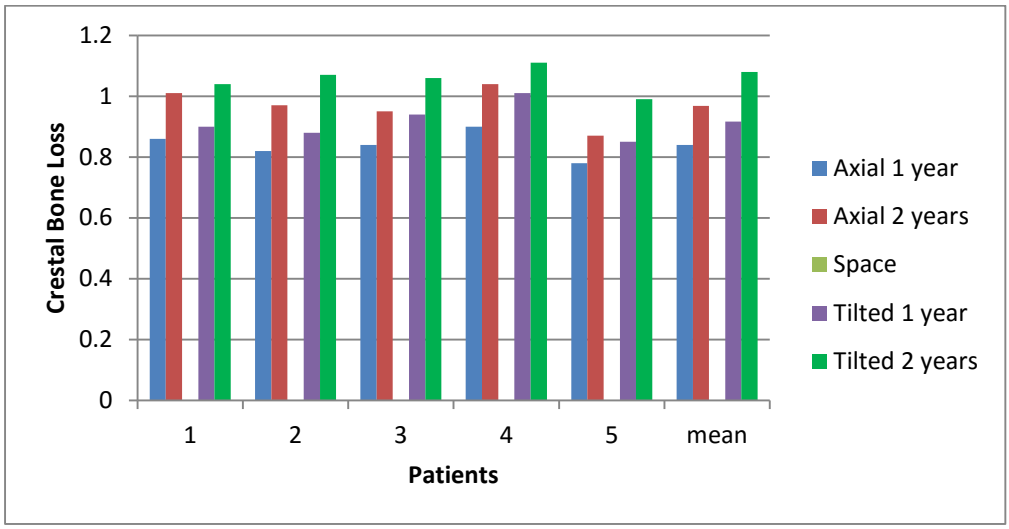

Figure 5: Comparison of posterior most implants at different intervals in both concepts