Original Research Paper

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An In-vivo Study to Evaluate and Compare the Crestal Bone Response after Loading Endosseous Implant with Two Different Types of Implant Abutment Connections: Internalhex and Conicalhex-a Prospective Comparative Interventional Clinical Study

Abstract:

Aim and Objectives: The aim of the study was to compare & assess crestal bone response after loading the endosseous implant between two different type of connection internal hex and conical hex connection with the help of radiographic examination.

Material and Method: In the present study two dental implant abutment connections were compared; the internal hex connection and conical or morse taper connection: the sample size for both connections were 10 each were divided in to 2 groups, group 1 internal hex (10 Adin Touareg-S) and group 2 conical hex connection (10 Adin Touareg Close-Fit). The connections were evaluated at various time interval after loading and compared with the base line radiograph at 3rd ,6th, 9th& 12th months. The reference range was taken as the amount of bone available at the time of placement of the prosthesis. An intra oral periapical radiograph technique was followed. The bone loss was assessed at both the mesial and distal surface along the length and diameter of implant using the image J software.

Results: The results were obtained and statistical analysis was done by Unpaired t test, Repeated measure ANOVA test and Post- hoc Bonferroni test.it was found that the internal hex and conical hex connection did not have any significant difference in bone loss at the of 3rd& 6th months, but the connection showed significant difference by the end of 9th and 12th months where the bone loss was more in internal hex when compared to conical hex.

Conclusion: This study concluded that crestal bone loss was less in conical hex connection when compared to internal hex connection and it was statistically significant. The marginal bone loss was assessed with the help of image J software, which was examined radiographically under 12 months follow up.

Key-words: Crestal bone loss, Internal hex, Conical hex, Dental Implants

Introduction:

The aim in treating patients in the field of dentistry is to restore normal form, function, esthetics, phonetics, comfort and health. Implant dentistry has been used as a modality to replacement and strength for decades now with high predictable success rates.[1]

The implant abutment connection is a weak link and hence extensive studies are being conducted to make this interface connection a strong one so that it increases the life of the prosthesis and implant too. The implant abutment interface can have a gap which result in bacterial leakage and may lead to bone loss. The geometry design of the internal hex and

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external hex can have a gap at the interface and there are studies to show that it leads to bone loss. To overcome this issue another geometrical design, the conical connection, which is retained by friction and which snuggly fits at the interface was introduced. There are various studies which state that conical implant abutment interfaces create very less gap and hence it prevents bacterial accumulation[2]. Dental implant system used to support single or multiunit prosthesis for partially single or complete edentulous patients[3]. Implant body may be divided in to three parts: crest module, body, apex. As time goes slowly, there is a huge evolution in implant dentistry. Dental implant was popularized from 1687. There is great evolution happening till today. In the current time the research in the field of implant is going on at a substantial level. The material of choice for the implant is titanium which is highly researched for its biocompatibility. This material is replaced by zirconia as it is considered to give better results in terms of osseointegration when compared to titanium implant[4]

Thus, gaining popularity According to some researchers like Hansson the morse taper design have a deeper stability within the implant than other designs. It can resist larger load and distribute the force equally thus decreasing the load in crestal region. Taper abutment design decreases the load transfer on the bone, studies show that taper implant abutment connection has better load transmission, as it is based on principle of platform switching, which reduces the marginal bone loss around the implant[5].

Need for this study:

There is little evidence in literature on relationship between the implant abutment interface and stress distribution pattern on implant, its component and surrounding bone. This study has been taken up to evaluate the marginal/ crestal bone loss using two different implant abutment connection design.

Study Design:

A Prospective **Comparative Interventional Clinical Study**

Surgical procedure:

Selected cases underwent a thorough scaling and all teeth that required fillings or RCT were restored. The diagnostic cast was prepared after making impressions with alginate.

Stage 1: Surgical phase :

During first stage surgical phase, the operating room is completely fumigated 24 hours before the procedure. Patient and operator were made to wear a sterile surgical gown. Patient was seated on the dental chair and was asked to gargle using mouthwash. Then thorough scrubbing of facial region. Local anaesthesia lignocaine with 1:80,000 adrenalinewas administered using nerve block, as per the requirement along with local infiltration. After confirming the thorough onset of anaesthesia, mid crestal incision was given using 15 no. surgical B.P. blade. A full thickness flap was reflected and a further releasing incision were given on either side of buccal flap. Osteotomy procedure was performed according to manufacturer recommendation. A pilot drill of 2 mm diameter was intraorally used to the required length of the implant. An RVG has been taken to confirming the length by placing depth gauze. Osteotomy was continue using successive drills till the required penultimate drill. A depth gauze was placed at the osteotomy site and an RVG was taken to reconfirm the length of the prepared site. Once the depth was satisfactory, implant of the required diameter was taken using mount driver and attached to the ratchet. The implant was placed in the osteotomy site and it tightened to its final position. After thorough irrigation both the flaps were approximated. An interrupted Suture was done using a 4-0 mersilk suture material. And then post-operative instruction was given[6,7]

Patient were recalled after 24 hours for a follow up. The patient was asked if they hadexperienced any pain or discomfort. The surgical site was examined and the patients were recalled after a week for suture removal. In this study all the patients were recalled after definitive prosthesis was given. The period of evaluation was 1 months, 6months, 9 months and finally 1 year to assess the amount of marginal bone loss.

Stage 2 Surgical phase: (second stage):

The patient was recalled after a period of 3 months and was evaluated for using X-ray to see ifadequate osseointegration had occurred. An X incision was placed on the implant site and healing abutments were attached to the implants. After 2week the patients recalled an open tray impression. The impression made with elastomeric impression material (PhotosilDPI India) with the help of putty wash technique. All the impression was made was disinfect using Iodophor. A metal try in was done then definitive prosthesis were given to the patients. Baseline radiograph was made for comparison with the follow up radiograph. Patient was recalled every 3,6,9 months. after prosthesis placement and follow up radiograph were made. These radiograph was used to compare with base line radiograph for assessing the marginal bone loss for all the patients

Follow up:

Follow up was done in following months:

After giving definitive prosthesis- first X- ray (Baseline radiograph), 3rd month post prosthesis follow up - 2nd radiograph, 6th month post prosthesis follow up - 3rd radiograph ,9th month post prosthesis follow up - 4th radiograph,one-year post prosthesis follow up -5th radiograph

Evaluation criteria:

Postoperative evaluation of delayed loaded implants was assessed on both the mesial and distal surface of the implant to see the amount of marginal bone loss.

Evaluation of crestal bone levels:

Standardized periapical radiograph was used to measure marginal bone loss. Aparalleling cone technique with XCP holder was used to measure the bone changes that occurred in the subsequent visits of the patients. Angulation and the position of the film was standardized by using a custom-made occlusal jig. The bone loss was evaluated in the X ray from the shoulder of the implant. Occlusal jig was made with elastomeric impression material[8].

Marginal bone loss was evaluated using the following formula[9]

$$\text{Marginal bone loss} = \frac{\text{Actual Implant Length} \times \text{change in bone loss } (T_1 - T_0)}{\text{Actual implant length visible on X-Ray}}$$

$$\text{Change in marginal Bone level } (\Delta IBL) = T_1 - T_0$$

T_0 = At Time zero after definitive prosthesis given

T_1 = At time one month after definitive prosthesis given

Eg- marginal bone loss $= \frac{11.5 \times .5}{12}$

$= .28$ mm

Actual implant length = 11.5 mm

Change in bone level = .3 mm

Actual implant length visible on X- ray = 12 mm

Results:

Table:1 comparison of marginal bone loss in both study groups

Marginal bone loss	Internal hex connection		Conical hex connection		Mean Difference	t-test value	p-value
	Mean	Std. Deviation	Mean	Std. Deviation			
After loading	0.00	0.00	0.00	0.00	0.00	0.000	1.000
at 3 months	0.43	0.14	0.39	0.14	0.04	0.654	0.221
at 6 months	0.57	0.14	0.54	0.12	0.03	0.688	0.200
at 9 months	0.92	0.12	0.87	0.12	0.05	2.091	0.047*
at 12 months	1.22	0.12	1.16	0.11	0.06	2.500	0.045*

Unpaired t-test* Significant difference

The mean marginal bone loss after loading, at 3rd months, at 6th months, at 9th months and at 1 year was compared between Internal hex connection and Conical hex connection using the unpaired t-test. The mean Marginal bone loss after placement at 9 months and at 12 months was significantly more among Internal hex connection when compared to Conical hex connection.

Table:2 overall mean marginal bone loss in group 1(internal hex connection) study groups:

Marginal bone loss after placement	Internal hex connection		Critical value	p-value
	Mean	Std. Deviation		
after loading	0.00	0.00	12.093	< 0.001*
at 3 months	0.43	0.14		
at 6 months	0.57	0.14		
at 9 months	0.92	0.12		
at 1 year	1.22	0.12		

Repeated measures ANOVA test * Significant difference

The crestal bone loss (over-all) after giving prosthesis was compared between 3 months, 6 months, 9 months and 1 year using the repeated measures ANOVA test. Significant difference found in crestal bone loss (over-all) after placement of prosthesis was compared between 3rd, 6th& 9 months and 1 year.

Table:3 over all inter-interval comparison of mean marginal bone loss

		Mean difference	p-value
after loading	at 3 months	-0.43	0.045*
after loading	at 6 months	-0.57	0.043*
after loading	at 9 months	-0.92	0.024*
after loading	at 1 year	-1.22	0.001*
at 3 months	at 6 months	-0.14	0.125
at 3 months	at 9 months	-0.49	0.040*
at 3 months	at 1 year	-0.79	0.033*
at 6 months	at 9 months	-0.35	0.047*
at 6 months	at 1 year	-0.65	0.035*
at 9 months	at 1 year	-0.31	0.048*

Post-hoc Bonferroni test * Significant difference

Table 3 shows the overall marginal bone loss within the group at different time intervals using the post-hoc Bonferroni test. crestal bone loss raised from after giving prosthesis to 3rd& 6th months to 9th months to one year.

Table:4 overall comparison of mean marginal bone loss in group 2(conical hex connection) study group:

Marginal bone loss after placement	Conical hex connection		Critical value	p-value
	Mean	Std. Deviation		
after placement	0.00	0.00	11.300	< 0.001*
at 3 months	0.39	0.14		
at 6 months	0.54	0.12		
at 9 months	0.87	0.12		
at 12 months	1.16	0.11		

Repeated measures ANOVA test * Significant difference

The marginal bone loss (over-all) after giving prosthesis was compared between 3 months, 6 months, 9 and 12 months using the repeated measures ANOVA test.

Table:5 overall evaluation of marginal bone loss:

		Mean difference	p-value
after loading	at 3 months	-0.39	0.046*
after loading	at 6 months	-0.54	0.044*
after loading	at 9 months	-0.87	0.025*
After loading	at 1 year	-1.16	0.001*
at 3 months	at 6 months	-0.15	0.126
at 3 months	at 9 months	-0.48	0.041*
at 3 months	at 1 year	-0.77	0.034*
at 6 months	at 9 months	-0.33	0.048*
at 6 months	at 1 year	-0.62	0.036*
at 9 months	at 1 year	-0.30	0.049*

Post-hoc Bonferroni test * Significant difference

Table5 shows the overall marginal bone loss within the group at different time intervals using the post-hoc Bonferroni test.



Fig.1 X-Ray after loading at 9th month (Conical Hex Connection)



Fig.2 X-Ray after loading at 1 year (Conical Hex Connection)

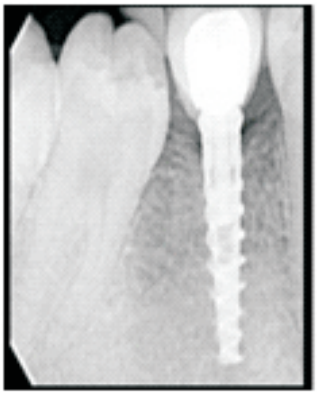


Fig.3 X-Ray after loading at 9th month (Internal Hex Connection

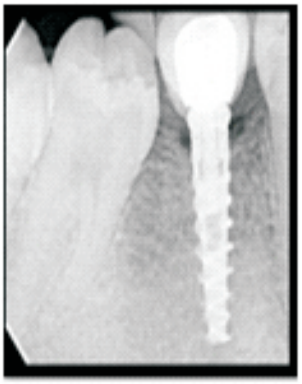
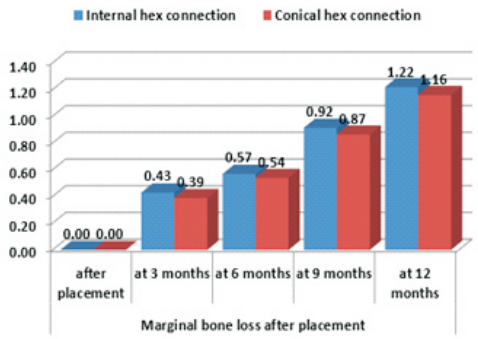


Fig.4 X-Ray after loading at 1 year (Internal Hex Connection)

Graph



Discussion:

The oral environment is conducive for the growth of these bacteria within the implant abutment connection and hence it can lead to peri-implantitis. Which finally result in bone loss. According to Buitrago Osuna et al E. Coli bacteria were used and growth in aerobic condition and they found it lead to peri-implantitis[10].

Simonetta D'Ercole et al done an in vitro study in which they placed different implant abutment interface that is internal and conical hex connection; in which they analyzed the bacterial accumulation. if there is gap present between implant abutment interface, then it can lead to screw loosening which can cause peri-implantitis. According to this study bacterial accumulation was less in conical connection than internal hex connection. So, there was less marginal bone loss in conical hex connection[11]. In this present study also, it is found that less marginal bone loss was observed in conical hex connection than internal hex connection and it is statistically significant.

Branemark and his co-workers from the evolution of implant, worked on implant abutment interface for the implant survival. According to Norton et al evolution in implant abutment interface is necessary because it causes implant failure in various aspect like screw loosening and implant fracture. To overcome this type of situation manufacturer, develop torque driver so that it will increase the contact between implant and abutment and fit very precisely Therefore, this joint is more stable. Norton et al done the in vitro study on two different implant system, that is Astra and Nobel BioCare, which has butt joint and conical joint connection. In this study they found that increased resistance to bending moment in internal conical hex is more than butt joint connection.[12]

Gustavo Passarelli Petris et al had done an invitro study to assess the stress distribution of the implant abutment prosthesis and adjacent assembly. They have done study with implant with solid abutment and implant with screw retained abutment. They conducted that M_1 model has higher values in the first grooves of implant abutment interface then M_2. The present study observed that long implant abutment connection resulted in less bone loss due to the wide area of contact between implant abutment connection, thereby favoring broad distribution of the masticatory load with the surrounding bone[13].

Conclusion:

This study can be concluded by stating that marginal bone loss was more in internal hex when compared to conical hex connection when evaluated radiographically. There was statical significance in bone loss in the internal hex when compared to conical hex connection. There is also an increase in bone loss observed in 9th and 12th month after loading which was statically significant. The inter- interval comparison also show increase in bone loss in both the mesial and distal surface of implant from the 3rd month to 12th month of the implant. This study was done for a period of one year and it should be continued for a longer period of time (4-5 years) to help us get a detailed picture of the amount of bone loss when different connections are used. This study can be modified by adding microbiological findings at the implant abutment junction which will give us a clear picture of the role of micro-organism in bone loss process.

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