Comprehensive evaluation of peri implant bone loss in patients receiving mandibular implant supported over dentures- A cone beam computed tomography based clinical (Original Research) Study

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Abstract- Background and Aim: Crestal bone is a routine phenomenon around newly installed implant in the jaw bone. It shows different pattern as per patients habits and oral hygiene. Many clinical approaches have been discussed over the years to deal with this issue. Severe bone loss can eventually lead to implant mobility and exfoliation. The sole endeavour of present study was to assess peri-implant bone loss in implant supported over dentures patients. It was completed utilizing cone beam computed tomography. Materials & Methods: Firstly, twenty new completely edentulous patients were selected from the regular opd of the department. Complete dentures were fabricated by usual manner. Two implants were decided to be placed in the bilateral canine regions in the mandibular arch. Standard osteotomy procedures were utilized for it. Authors planned to evaluate crestal bone losses around these implants. All four surfaces (mesial, distal, buccal, lingual) of implants were analyzed for bone loss at different time intervals. Bone losses were estimated after two months, four months and six months. Group one, group two and group three implants included in which crestal bone loss around all surfaces evaluated after two months, four months and six months respectively. Cone beam computed tomography was used to calculate bone levels around each implant at the time period of two months, four months and six months. Informed consent was taken from the patients. Statistical Analysis and Results: Statistical analysis was done by statistical software Statistical Package for the

Social Sciences (SPSS). The resultant data was sent to suitable statistical tests to achieve p values, mean, standard deviation, standard error an 95% CI. P ≤ 0.05 was considered as statistically significant. All patients were further separated into five age groups. 2 patients were selected in the age range of 45-52 years. P value was not significant here. 4 patients were noticed in the age range of 52-58 years. P value was not significant for this age group. Total nine patients were identified in the age range of 59-65 years. Level of significance evaluation by pearson chi-square test [for group I and group III] shown significant values of p for all four studied surfaces [mesial, distal, buccal, lingual]. Conclusion: Within the limitations of the study, authors concluded that there was obvious crestal bone loss around the implant surfaces. These losses were identified in all three time intervals of study. Relative crestal bone loss was minimum in the first two months on implant placement and maximum in the first six months on the implant placement. Authors also noticed significant differences in bone losses in first two and first six month of implant placement. However, CBCT assessment also verified that this relative increase of bone loss in six months was very minute.

Key words: Cone Beam Computed Tomography, Complete Denture, Crestal Bone Loss, Dental Implants

1. INTRODUCTION

In the completely edentulous patients, retention is a very common problem since decades. Several techniques and methods have been employed by various researchers for successful management of these issues. With the introduction of dental implant, these dilemmas have been resolved to a certain extent.[1,2] Such types of implant retained complete dentures are called implant supported dentures or implant over-denture. These overdenture therapies have led to increased treatment options for patients who are either partially or completely edentulous.[3,4] Nonetheless, it has become obvious that while this therapy is successful in several patients, implant supported complete dentures are not devoid of post treatment complications. Peri implant bone loss is one of the major post operative complications which ultimately lead to implant failure. Accordingly, complete dentures are also a failure.[5,6] Therefore peri implant bone losses are needed to be managed genuinely. The most common aetiology of this crestal bone losses are Peri-implantitis. Peri-implantitis is defined as an inflammatory process distressing the supporting hard and soft tissue around an implant in function, resulting in to loss of surrounding alveolar bone.[7,8] The marginal bone loss surrounding dental implants is a vital indicator that helps to estimate the course and the final outcome of implant-prosthetic treatment. Hence, it is very crucial to recognize the factors that may affect this. Biologic complications related with dental implants are mainly correlated to infection in the soft and hard tissue around implants. These processes are commonly known as peri implantitis.[9,10] Most of the pioneer workers in the literature highlighted poor oral hygiene, history of periodontitis, and smoking as being the strongest risk indicators for peri implantitis. The durability of dental implants is extremely dependent on incorporation between implant and oral tissues, including hard and soft tissues.[11,12] Literature have well evidenced that osseointegrated titanium implants had 0.5 to 1.4 mm marginal bone loss from the first thread by the end of the first year in function, whereas only 0.05 to 0.13 mm bone loss happened after the first year.[13,14] This study was attempted to assess peri-implant bone

loss in implant supported over dentures patients. It was completed utilizing cone beam computed tomography.

2. MATERIALS & METHODS

This study was planned, outlined and executed in the department of Prosthodontics of the institute. Initially, twenty new completely edentulous patients were selected from the regular opd of the department. Pure randomized sampling procedure was employed in the selection procedure. Inclusion criterion included moderately available ridges, absence of any soft tissue deformity, absence of any deviation in the mandibular opening and closing, no gross pathology associated with temporo-mandibular joint, accepted salivary flow. Exclusion criterion included any gross anomaly associate with maxillofacial structures, severely resorbed alveolar ridges, xerostomia, mentally retarded patients and smokers. After recording comprehensive case history, primary impressions were made and followed by border moulding with final impressions. Jaw relations were recorded by usual manner followed by try in of waxed denture. Dentures were processed by compression moulding technique using heat cure acrylic resin. Finished and polished complete dentures were inserted in the patients mouth. Soon after delivery of the dentures, mandibular dentures were planned to make more retentive by osseointegrated dental implants. So, all fabricated conventional complete dentures were planned to be converted into implant supported over-dentures. Two implants were decided to be placed in the bilateral canine regions in the mandibular arch. Standard osteotomy procedures were utilized for it. Authors planned to evaluate crestal bone losses around these implants. All four surfaces (mesial, distal, buccal, lingual) of implants were analyzed for bone loss at different time intervals. Bone losses were estimated after two months, four months and six months. Hence, efficiently authors proposed to study bone losses around forty implants at all four surfaces. For the ease of study and statistical analysis, implants were studied and divided into three groups as per their timing of evaluations. Group one implants included wherein crestal bone loss around all surfaces evaluated after two months. Group two implants included wherein crestal bone loss around all surfaces evaluated after four months. Group three implants included wherein crestal bone loss around all surfaces evaluated after six months. Cone beam computed tomography was used to calculate bone levels around each implant at the time period of two months, four months and six months. Implant placement pre-planning was also taken into considerations (virtual placement of suitable sized implants and with correct angulations as suggested by cbct, figure 1). All four surfaces i.e; mesial, distal, buccal and lingual were analyzed by three dimensional radiography cone beam computed tomography. Actual bone losses were estimated by the radiographic images made immediately after implant placements. Therefore these initial radiographs were acting as control group. By comparing the data with control group, real time bone losses were assessed and recorded. Informed consent was taken from the patients those were voluntarily ready for involvement. Immediately before the implementation of the study, authors had explained the literal importance of this study to all selected patients. The privacy and other incorporated rights of the patients along with their freedom of expression were not disclosed. Results thus received was compiled in table and subjected to basic statistical analysis. P value less than 0.05 was considered significant ($p < 0.05$).

3. STATISTICAL ANALYSIS AND RESULTS

In the current study, all obvious findings and data were gathered in logical manner. Compiled data was sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The processed data was subjected to suitable statistical tests to obtain p values, mean, standard deviation, chi- square test, standard error and 95% CI. Table 1 and Graph 1 showed that out of 20 patients, males were 13 and females were 7. All patients were further separated into five age groups. 2 patients were selected in the age range of 45-52 years. P value was not significant here. 4 patients were noticed in the age range of 52-58 years. P value was not significant for this age group. Total nine patients were identified in the age range of 59-65 years. P value was significant for this age group (0.02). Consequently, it can be presumed that approximately half of the studied patients were in third age groups. Table 2-7 illustrated fundamental statistical description with level of significance evaluation using Pearson chi-square test [for Group I, II and III]. Authors noticed that relative crestal bone loss was minimum in the first two months (group I) on implant placement and maximum in the first six months on the implant placement (group III). Level of significance evaluation by pearson chi-square test [for group I and group III] shown significant values of p for all four studied surfaces [mesial, distal, buccal, lingual]. Table 8 showed comparison of mean bone losses among the 3 study groups using one-way ANOVA [for group I, II, III]. The measured p value was very significant (0.001). Table 9 showed Two sample T- Test for comparison of variables between Group I, Group II and Group III. P value was highly significant (.001) for only mesial surface.

Table 1: Age & gender wise allocation of patients

Age Group (Yrs)	Male	Female	Total	P value
45-51	1	1	2	0.80
52-58	3	1	4	0.50
59-65	6	3	9	0.02*
66-72	2	1	3	0.06
>72	1	1	2	0.10
Total	13	7	20	*Significant

Table 2: Fundamental statistical depiction [for group I: evaluated after two months by cbct]

Surfaces [for all 40 implants]	Mean Bone Loss	Std. Deviation	Std. Error	95% CI
Mesial	0.41	0.834	0.726	1.19
Distal	0.47	0.342	0.384	1.96
Buccal	0.52	0.849	0.928	1.72
Lingual	0.59	0.938	0.283	1.92

Table 3: Level of significance evaluation by pearson chi-square test [for group I: evaluated after two months]

Surfaces [for all 40 implants]	Pearson Chi-Square Value	df	Level of Significance (p value)
Mesial	1.728	2.0	0.01*
Distal	1.267	2.0	0.04*
Buccal	2.728	1.0	0.02*
Lingual	1.425	1.0	0.01*

***p<0.05 significant**

Table 4: Fundamental statistical representation [for group II: evaluated after four months by cbct]

Surfaces [for all 40 implants]	Mean Bone Loss	Std. Deviation	Std. Error	95% CI
Mesial	0.70	0.738	0.324	1.96
Distal	0.63	0.829	0.029	1.82
Buccal	0.61	0.524	0.052	1.96
Lingual	0.67	0.993	0.425	1.61

Table 5: Level of significance evaluation by pearson chi-square test [for group II: evaluated after four months]

Surfaces [for all 40 implants]	Pearson Chi-Square Value	df	Level of Significance (p value)
Mesial	1.728	1.0	0.50
Distal	1.820	2.0	0.90
Buccal	1.821	1.0	0.50
Lingual	1.837	1.0	0.08

***p<0.05 significant**

Table 6: Fundamental statistical representation [for group III: evaluated after six months by cbct]

Surfaces [for all 40 implants]	Mean Bone Loss	Std. Deviation	Std. Error	95% CI
Mesial	0.76	0.425	0.102	1.96
Distal	0.79	0.938	0.029	1.92
Buccal	0.86	0.039	0.837	1.16
Lingual	0.88	0.063	0.029	1.64

Table 7: Level of significance evaluation by pearson chi-square test [for group III: evaluated after six months]

Surfaces [for all 40 implants]	Pearson Chi-Square Value	df	Level of Significance (p value)
Mesial	1.839	1.0	0.02*
Distal	1.029	2.0	0.01*
Buccal	1.837	1.0	0.04*
Lingual	1.635	1.0	0.01*

***p<0.05 significant**

Table 8: Comparison of mean bone losses among the 3 study groups using one-way ANOVA [for group I, II, III]

Parameters	Degree of Freedom	Sum of Squares ∑	Mean Sum of Squares m∑	F	Level of Significance (p value)
Between Groups	3	6.890	1.984	5.960	0.001*
Within Groups	49	19.946	0.356	-	
Cumulative	521.87	22.908	-		

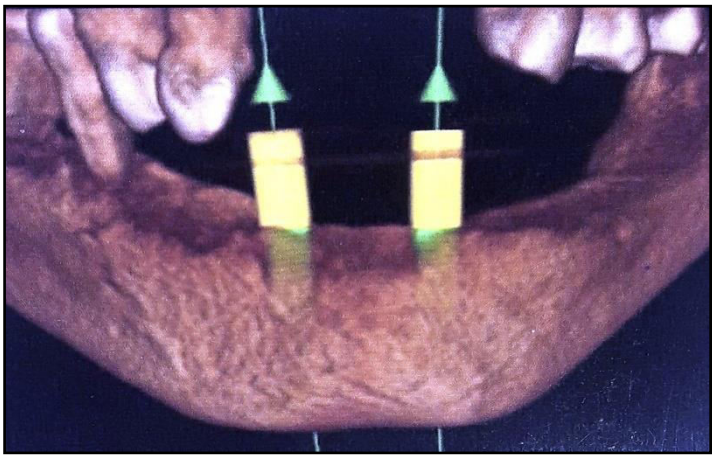
***p<0.05 significant**

Table 9: Two sample T- Test for comparison of variables between Group I, Group II and Group III

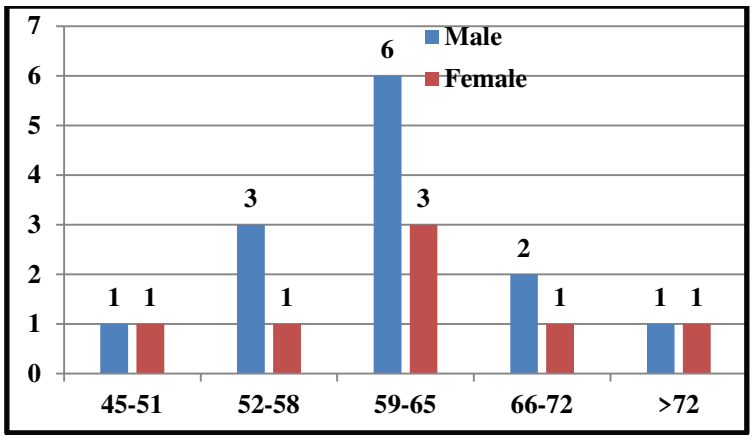
S.No.	Variables	Group I		Group II		Group III		p Value
		Mean	S.D.	Mean	S.D.	Mean	S.D.	
1.	Mesial	0.41	0.834	0.70	0.738	0.76	0.425	0.001*
2.	Distal	0.47	0.342	0.63	0.829	0.79	0.938	0.647
3.	Buccal	0.52	0.849	0.61	0.524	0.86	0.039	0.069
4.	Lingual	0.59	0.938	0.67	0.993	0.88	0.063	0.435

***p<0.05 significant**

Figure 1: Implant placement pre-planning as depicted by CBCT (virtual placement of suitable sized implants and with correct angulations)



Graph 1: Age & gender wise allocation of patients



4. DISCUSSION

As we all are aware that the introduction of dental implants has formed a paradigm shift in the oral rehabilitation of patients. Literature is overwhelmed with the studies on the success and failure rates of dental implants. Also, there is a clear shifting trend in the choice of treatment.[15,16] It has been shifted to fix from removable as far as the prosthodontic work is concerned. Implant related prosthesis is often proven and well-established therapy which helps to restore esthetics. Implant related prosthesis also manages oral function resulted from tooth loss.[17,18] Many of the researchers over the decades have showed the secure use of dental implants. However, researchers have also stated that in spite of the high success and survival rates of dental implants, failures also happen.[19,20] It is therefore very important for implant-supported prosthesis to be maintained time to time. This maintenance is mostly related to the oral hygiene. Smoking is one of the most deleterious factors affecting the long term implant success and survival.[21,22] According to American Academy of Periodontology, peri-implantitis is defined as an inflammatory process around an implant, including both soft tissue inflammation and progressive loss of supporting bone beyond biological bone remodeling. The sole criteria of clinical success in dental implant treatment of missing teeth include implant immobility, absence of pain and peri-implant bone loss below 1.5 mm (as seen on radiograph), as well as healthy soft tissues surrounding dental implants.[23,24] Durable implant-supported mandibular over denture usually provide imperative information about its clinical success. Ideally, all implant retained over dentures must survive as long as possible. Nevertheless, no apparent clinical sign of failure or bone loss should be seen especially within the first five years of service.[25,26] Many of the researchers believe this as one of the major criteria of long term success of implant retained over dentures. Previous studies illustrate that peri implantitis induced crestal bone loss increases with patients age. However, few of the studies conducted on effects of smoking on implant showed that crestal bone loss is not directly linked with gender and smoking tendency.[27] Therefore, it is still a matter of debate as different schools of thoughts are there in the literature. It is therefore very clear that comprehensive success of implant retained complete denture or overdenture is only assured by healthy bony and soft tissue milieu. Any noticeable microbiological encroachment can lead to development of peri implant diseases. This dilemma has also been managed clinically by certain design modifications in the implant and abutment. Most common and popular technological consideration is platform switching. Generally, any crestal bone loss at the

coronal part of the implant is one of the early signs of peri implant disease. Literature has also evidenced that the chief reason of peri implant bone loss may be multi-factorial in origin.[28,29]

5. CONCLUSION

Authors have drawn few very significant conclusions from this study. There was evident crestal bone loss around the implant surfaces. These losses were noticed in all three time intervals of study. Relative crestal bone loss was minimum in the first two months on implant placement and maximum in the first six months on the implant placement. Authors also noticed significant differences in bone losses in first two and first six month of implant placement. However, CBCT assessment also verified that this relative increase of bone loss in six months was very minute. Hence, it is confirmed that such a fine bony details can only be revealed by advanced three dimensional radiographic methods like cone beam computed tomography. Therefore, it is suggested to use cone beam computed tomography for such critical circumstances. Cone beam computed tomography can also be judiciously used for accurate dimensional analysis and virtual placement of dental implants. Nevertheless, authors expect few other genuine studies to be conducted with larger sample size and wider parameters.

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