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An Invitro Assessment of Crestal Bone Loss in Prefabricated and Castable Abutments

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ABSTRACT

Introduction: Crestal bone loss around implants may be regarded as threat to durability of the implant treatment.

Objectives: To evaluate and compare the crestal bone loss in prefabricated titanium abutments and castable cobalt-chromium abutments.

Methods: The present study was conducted on five partially edentulous patients seeking fixed replacement of missing teeth. Each of the patients received Prefabricated abutments on the right side (Group 1, n=5) and Castable abutments on the left side (Group 2, n=5). Intraoral periapical radiograph and orthopantomogram were evaluated to assess the available bone height and width and vital structures. Patients were reviewed after 3 months. The measurement of bone levels on the mesial and distal side of the implant was performed parallel to the long axis of the implant from point of reference to the first bone-to-implant (BIC).

Results: Mean values for group 1 and group 2 at the time of loading and 3 months after loading does not shows a significant difference. When compared to group 1 the crestal bone loss for group 2 was found to be less at the time of loading and after 3 months of loading.

Conclusion: It is concluded that there was no significant crestal bone loss between prefabricated and castable abutments at the time of loading while there is a significant increase in bone loss for prefabricated abutments after 3 months of loading.

Key Words: Implants, Crestal, Bone loss, Prefabricated, Castable

INTRODUCTION

Prosthesis to rehabilitate missing teeth has undergone a sequence of changes across the years.¹ The available treatment modalities for partially edentulous patients are provisional removable partial denture, cast partial denture, fixed partial denture, resin bonded prosthesis, and implant prosthesis.² The primary reason to suggest or perform a treatment should not only be related to treatment time, cost, or difficulty to perform but also should reflect the best possible long-term solutions for each individual.

In recent years, dental implants are becoming the gold standard treatment for replacing the missing teeth. This has attained a high rate of success previously. Most of the other treatment options cause residual ridge resorption thereby complicating esthetics. This can be avoided with implant

therapy which can maintain the alveolar bone.³ They represent many advantages, such as adjacent teeth do not require splinted restorations, improved hygiene conditions, decreased cold or constant sensitivity, improved esthetics, maintenance of arch form and bone in the site, decreases adjacent tooth loss and psychological advantages.⁴ An abutment is a constituent that is intermediate between the implant and the restoration and is reserved to the implant by a screw or locking taper. Implant abutments may be prefabricated or custom made. Prefabricated abutments are machine-made. And they are economical and simple to use. It can be directly adapted to the implant. And implant level or abutment level impression can be taken. Custom abutments are fabricated in a dental laboratory. They are used when the prefabricated abutments cannot be modified.

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Crestal bone loss around implants may be regarded as a threat to the durability of the implant treatment. The aetiology for crestal bone loss was considered as multifactorial and it occurred at early and later stage of dental implants. Early crestal bone loss occurs in one year after implant placement due to bone remodelling and early loading. Later crestal bone loss occurs due to chronic etiological factors such as environmental, immunological, patient factors, i.e. smoking, infection, and bruxism and clinician factors.⁵

Crestal bone can be measured using different imaging techniques they are standard intraoral radiographs, panoramic radiographs, computerized tomography scans, and cone-beam computerized tomography scans. Studies showed that the accuracy of measuring the crestal bone loss is affected by superimposition and structure distortions in the panoramic radiographs, overexposure and metal artefacts in computerized tomography scans. Today, for standard assessment of crestal bone levels standard intraoral radiography and cone beam computerized tomography scans are considered as suitable methods.^{6,7}

There is a lack of literature evaluating crestal bone loss for castable cobalt-chromium abutments. This study aims to evaluate and compare the crestal bone loss in prefabricated titanium abutments and castable cobalt-chromium abutments at the time of implant placement, at the time of implant loading and after 3 months of loading using intraoral periapical radiographs.

MATERIALS AND METHODS

This study was performed on 5 partially edentulous patients looking for fixed replacement of lost teeth, who reported to the outpatient department of Prosthodontics and crown and bridge. Those patients with Bilateral mandibular posterior single tooth replacement, Adequate bone height and width, the Age range of 30-40 years and stable occlusion were included in the study. while all those patients with the history of restricted mouth opening, systemic disease, psychological disturbances, disorders of the temporomandibular joint and adverse habits were excluded from our study.

Sample collection

Five Patients with bilateral single posterior mandibular edentulous areas were selected for this study. Written informed consent was signed by the patient which serves as evidence for legal issues.

Pretreatment evaluation

Intraoral and extraoral examination was and Diagnostic impression made using irreversible impression material (DPI CHROMATEX) and poured with dental stone (type II). Patient referred for blood and radiographic investigation. Blood

pressure and routine blood analysis were assessed to check the systemic conditions. Intraoral periapical radiograph and orthopantomogram were evaluated to assess the available bone height and width and vital structures (Figure-1).

After Stent fabrication, Implant placement was done. Adin implant system was selected for the study. Local infiltration was administered with Lignocaine 2% with 1:100000 adrenalin. A crestal incision was made using No. 15 Blood Pressure blade, extending from mid-buccal to mid-lingual crevices of the adjacent tooth. A full-thickness mucoperiosteal flap was raised with the periosteal elevator on both the buccal and lingual aspect, which helps inadequate visualization of the implant site. The surgical stent was positioned in the patient's mouth. The pilot drill was used at the osteotomy site to mark the purchase point to avoid the slippage of the surgical drills. Implants of predetermined size were inserted into the osteotomy site using the torque wrench. A cover screw was then positioned on the implants. The flaps were approximated with simple interrupted suture with 3-0 braided silk suture. Post-operative medications were prescribed which included antibiotics and analgesics. Intraoral periapical radiograph and orthopantomogram (OPG) (Figure -1) with grid was taken.

Second stage surgery

Surgery was performed 3-4 months after implant placement. The circumferential incision made using surgical blade over the implant and soft tissue was removed. The cover screw was removed, and the healing abutment was placed for 10-15 days for the healing of soft tissues around it.

Implant impression was carried out with a closed tray technique. The healing abutments were removed from the implants (right and left mandibular posterior region) Transfer copings were attached to the implant. The impression tray with putty material was inserted into the patient's mouth and allowed to set. Then the impression was removed leaving the coping in the patient's mouth. Then the transfer copings were removed and attached to implant analogue and reinserted into the impression. The healing abutment was then replaced, which prevent the collapse of the soft tissue around the implant.

Healing abutments were removed, and titanium abutment was screwed on one side and castable/customized cobalt-chromium abutment on the other side using abutment screw. Then the implant PFM crowns were cemented over the abutments using glass ionomer luting cement. Excess material around the margins should be removed. Occlusion was checked using articulating paper. Intraoral periapical radiograph with grid was taken (Figure 2 & 3).

Patients were reviewed after 3 months. Intraoral periapical radiograph with grid was taken and evaluated. An E speed radiographic film size of 4x3cm was used in Dental (Intraoral)

AMS-6010E machine with the voltage of 70kvp at 8 miliseconds.⁶ The implant shoulder was selected as a reference point to identify the crestal bone loss. The measurement of bone levels on the mesial and distal side of the implant was performed parallel to the long axis of the implant from point of reference to the first bone-to-implant. Any crestal bone loss or gain was reflecting by negative or positive numbers, respectively.⁷

The radiographs were digitalized using Xdigi-USB. The Adobe Photoshop version 8 software was used to analyze the IOPAs with the grid. The metric analysis was carried out on a micrometre scale using measuring tool in the screen caliper software.

The radiographic evaluation of the implants, the measurements and data are taken from all the patients were tabulated for statistical study, Statistical analysis was carried out using Paired t-test⁸ to compare the bone loss along with Group 1 and 2 types of abutments.

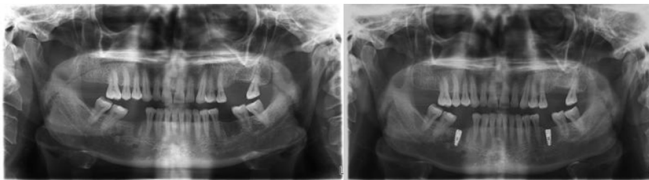


Figure 1: The radiographic evaluation (OPG) patients before and after implant placement.

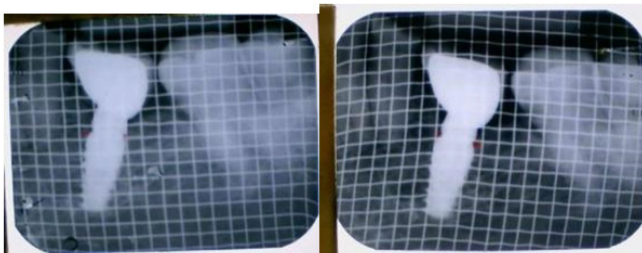


Figure 2: The radiographic evaluation of the implants using Intra oral peri apical radiograph with grids for group 1.

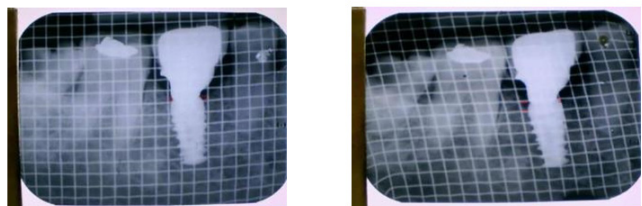


Figure 3: The radiographic evaluation of the implants using Intraoral periapical radiograph with grids for group 2.

RESULTS

This study compares the crestal bone loss amongst prefabricated Ti abutments and castable Co-Cr abutments on the mesial and distal aspects, at the time of placement, loading and 3-month review. The study was conducted at the Department of Prosthodontics in Vinayaka Mission’s Sankarachariyar Dental College on 5 bilaterally single posterior mandibular edentulous patients. Each of the patients received Prefabricated abutments on the right side (Group 1, n=5) and Castable abutments on the left side (Group 2, n=5).

Radiographs were used for the assessment of crestal bone loss at the time of implant placement, at the time of loading, at 3 months after loading on the mesial and distal aspect of all 10 implants.

Observed crestal bone loss in group 1 for prefabricated abutments for each patient at the time of implant placement, at the time of loading and 3 months after loading on the mesial and distal aspect are tabulated in Table 1.

Table 1: The observed crestal bone loss in Group 1-Prefabricated abutments

Cases	At the time of implant placement(mm)		At the time of loading (mm)		3 months after loading(mm)	
	Mesial	Distal	Mesial	Distal	Mesial	Distal
1	0	0	-0.09	-0.11	-0.41	-0.46
2	0	0	-0.10	-0.14	-0.43	-0.45
3	0	0	-0.17	-0.15	-0.55	-0.42
4	0	0	-0.16	-0.13	-0.54	-0.48
5	0	0	-0.11	-0.09	-0.43	-0.38

The observed crestal bone loss for each patient in group 2 with Castable abutments at the time of implant placement, at the time of loading and 3 months after loading on the mesial and distal aspect are tabulated in Table 2.

Table 2: The observed crestal bone loss in Group 2-Castable abutments

Cases	At the time placement (mm)		At the time of loading (mm)		3 months after loading (mm)	
	Mesial	Distal	Mesial	Distal	Mesial	Distal
1	0	0	-0.08	-0.10	-0.37	-0.44
2	0	0	-0.09	-0.11	-0.36	-0.33
3	0	0	-0.13	-0.09	-0.46	-0.39
4	0	0	-0.18	-0.15	-0.51	-0.37
5	0	0	-0.09	-0.07	-0.35	-0.25

On comparison, the average crestal bone loss for prefabricated Ti abutment was calculated as -0.125mm and for

castable co-cr abutment was -0.109 at the time of loading. But this difference the in crestal bone loss between group 1 and group 2 was not found to be significant at the time of loading.(p value=0.22) (Figure 4).

Further, the average crestal bone loss for prefabricated Ti abutment was calculated as -0.455mm and for castable co-cr abutment was -0.383mm at 3months after loading. The difference in crestal bone loss in group 1 and group 2 was found to be statistically significant at 3 months after loading (P-value =0.006) (Table-3).

Mean values for group 1 and group 2 at the time of loading and 3 months after loading does not shows significant difference. (Table 3, graph 1). When compared to group 1 the crestal bone loss for group 2 was found to be less at the time of loading and after 3 months of loading (Figure 5).

Table 3: Comparing the average crestal bone loss for each patient between group 1 and group 2 at the time of loading and 3 months after loading

Case no.	At loading		At 3 months after loading	
	Prefabricated	castable	Prefabricated	castable
1	-0.10	-0.09	-0.43	-0.40
2	-0.12	-0.10	-0.44	-0.34
3	-0.16	-0.16	-0.48	-0.42
4	-0.14	-0.14	-0.51	-0.44
5	-0.10	-0.1	-0.40	-0.30
mean	-0.125	-0.109	-0.455	-0.383
S.D	.026926	.033242	.041982	.058801
p value	.22		.006	

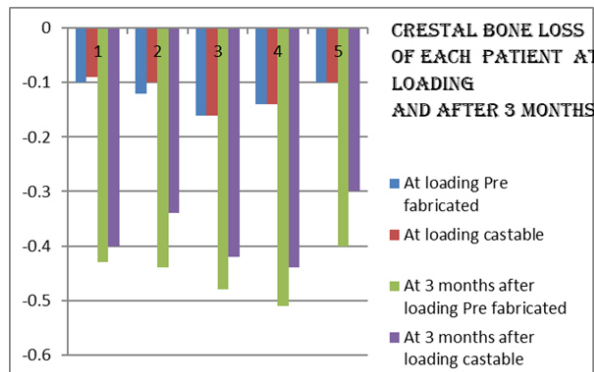


Figure 4: Comparing average crestal bone loss for each patient between group 1 and group 2 at the time of loading and 3 months after loading.

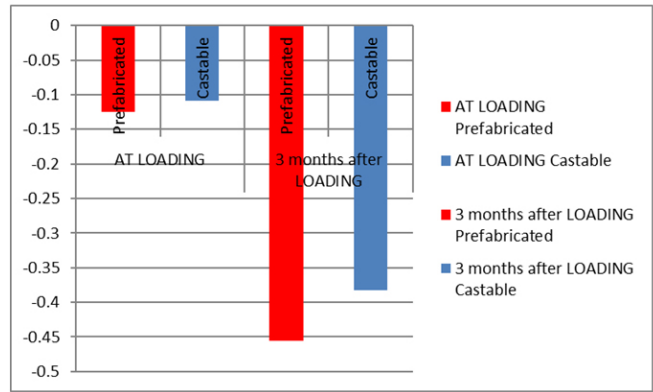


Figure 5: Comparison of crestal bone loss between group 1 and group 2 at the time of loading and after 3 months of loading.

DISCUSSION

Crestal bone loss around implants causes a threat to implant longevity. According to literature, initial bone loss during the first year after implant placement may be influenced by the number of factors such as peri-implantitis, micro gap, surgical trauma, biological width, occlusal overload and implant crest module.⁸ Implant-abutment connection in the two-stage system results in the micro gap (10-50 micrometres) which harbours gram-positive and gram-negative bacterial colonization and cause an inflammatory reaction of peri-implant soft tissues. After 1 year of loading 1.5mm-1.6mm of crestal bone loss was observed radiographically around implants. Therefore, evaluation of crestal bone loss is necessary for successful implant treatment. This study attempted to evaluate crestal bone loss in prefabricated titanium and castable cobalt-chromium abutments.⁹

Not much clinical studies were conducted to evaluate crestal bone loss with the use of various abutments. So the present study attempted to compare and evaluate crestal bone loss in prefabricated titanium abutment and castable cobalt-chromium abutment placed in the mandibular posterior region with the help of intraoral periapical radiographs with grids. According to Aaron Yu-Jen Wu, long term, clinical survival rates for two-piece implants up to 95% have been reported.¹⁰ Therefore in this study two-piece implants were used. Also in our study patients with bilateral posterior single edentulous patients were included where the crestal bone loss was minimal.¹¹ The radiographic examination provides information about the location of anatomical structures, the presence of infrabony lesions, the quality and quantity of available bone, the occlusal pattern and the number and size of implants as well as prosthesis design, these are essential for successful implant treatment. In the present study, XCP-Rinn apparatus was used to position the film and radiographs were taken using long cone paralleling technique.

In the present study conventional surgical stents were used for implant placement, which is economical and reliable using flap technique of implant placement was done; since it does not influence much change in crestal bone loss. According to Anirudh Bhattacharya, the crestal bone loss was more significant in immediate loaded implants than delayed loaded implants. In the present study, the patients were loaded with delayed loading protocol.³

In this study, patients were recalled for second stage surgery after the healing period of 3-4 months. The second stage surgical procedure was followed by Thomas Bernhard's minimally invasive second-stage procedure for single implants. This technique provides minimal trauma to soft tissues, short healing period and better esthetics.¹² An implant impression should record the spacial implant position to provide an accurate implant-supported prosthesis. The basic impression techniques are implanted level impression and abutment level impression. Recently digital impression has high accuracy at the microscopic level. In the present study, implant impressions were made using addition silicone impression material in stock trays. Implants were restored with cement-retained prostheses. Since cement-retained prosthesis provides better results for single implant crowns.¹³

The present study showed mean crestal bone loss of -0.125 mm for group 1 and -0.10mm for group 2 at the time of loading. And mean crestal bone loss of -0.435mm for group 1 and -0.383mm for group 2 after 3 months of loading. The mean values do not differ significantly at healing or loading phase but crestal bone levels vary significantly between at the time of loading and after 3 months of loading. Vinayak Bharete et al. assessed the consequence of dissimilar abutment materials on crestal bone height which by our findings. They compared the mean bone levels of titanium and zirconia abutments over 12 months. They concluded that the implant-abutment junction showed a time-dependent change in crestal bone height irrespective of abutment material. And the results showed zirconia abutments leads to the lesser reduction of crestal bone height compared to titanium abutments.¹⁴

Prefabricated and castable abutments showed a varied level of crestal bone loss on mesial and distal aspects. And there is no significant difference noted at loading and there was statistically significant difference noted after 3 months of loading between prefabricated and castable abutments. similarly, Lin et al compared different implant-abutment connections on crestal bone level they concluded that levels of does not differ significantly during healing or loading phase among the 3 implant connection designs. But the level of crestal bone changes significantly with a time interval.¹⁵

Similarly, Bhattacharya et al. evaluated marginal bone loss in delayed and immediate loaded implants. Their results showed variation in mesial and distal bone loss in both groups

at 3, 6, 12 and 18 months. And there was no statistically significant difference was noted at 3 months (mean -1.01mm) and 6 months (-0.070mm).³ Prefabricated abutments showed mean crestal bone loss of -0.455mm after 3 months of loading. Similarly, Mittal et al. evaluated marginal bone resorption in short dental implants at 3, 6, and 12 months after loading. Their results showed mean bone loss at 3 months after loading of 0.465mm. In this study, mean crestal bone loss for group 1 was -0.455mm and group 2 was -0.33mm.¹⁶ Castable cobalt-chromium abutments mean crestal bone loss of -0.109mm at the time of loading and -0.383mm after 3 months of loading. No similar studies were found in the literature to evaluate and comparing the crestal bone loss for castable cobalt-chromium abutments. It showed promising results after 3 months of loading. Therefore, further, follow up studies to evaluate crestal bone loss at different time intervals should be conducted.

CONCLUSION

Within the limitations of the study, the following conclusions were drawn, It is concluded that there is no significant crestal bone loss between prefabricated and castable abutments at the time of loading while there is a significant increase in bone loss for prefabricated abutments after 3 months of loading. If the sample size and duration of the study is increased it would provide us with a more significant difference between the prefabricated and castable abutments. Since the mean values of crestal bone loss in prefabricated and castable abutments do not show much variation, both can be used successfully for replacement of single posterior missing tooth using cement-retained crowns.

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Authors contribution

1. Dr. B.Rubashree,- investigation
2. Dr. Jayashree Mohan- Data collection
3. Dr. G.Rajkumar- Statistical analysis
4. Dr. Divya.Krishnamoorthi- Manuscript writing
5. Dr. Vignesh. V - Editing
6. Dr. Praveenraj. GR.- Funding, Editing

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