"EVALUATION OF CRESTAL BONE LEVELS AFTER PLACEMENT OF DENTAL IMPLANTS AND A FOLLOW-UP UPTO 5 YEARS – A RADIOGRAPHIC PERSPECTIVE"

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In

PROSTHODONTICS

By

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Batch: 2019-2022

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**EVALUATION OF CRESTAL BONE LEVELS AFTER PLACEMENT OF DENTAL IMPLANTS AND A FOLLOW-UP UPTO 5 YEARS – A RADIOGRAPHIC PERSPECTIVE"** is a bonafide and genuine research work carried out by me under the guidance of Dr. Amrit Tandan, Professor & Head, Department of Prosthodontics, Babu Banarsi Das College of Dental Sciences, Lucknow, Uttar Pradesh.

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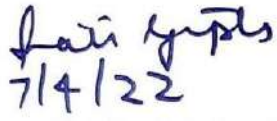

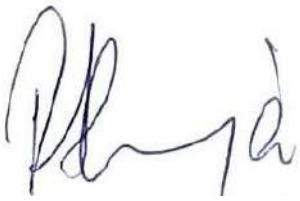

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Dedicated

To my

Beloved Parents

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"No one who achieves success does so without acknowledging the help of others."

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BEST REGARDS

Dr. Arushi Agarwal

TABLE OF CONTENTS

LIST OF PICTURES

LIST OF TABLES

LIST OF GRAPHS

LIST OF ANNEXURES

Abstract

BACKGROUND: Over many years, success has been evaluated by the survival rate, radiographic crestal bone loss, prosthesis stability and the presence of peri-implant diseases. Evaluation of bone loss around dental implants by using periapical radiographs has been frequently used and ensure favorable prognosis. For long-term results of endosseous implants, the maintenance of osseo-integration and a stable marginal bone level is necessary for implant success. Radiographic assessment of dental implants is a component of previously reported criteria for success. Correct usage and scientifically sound interpretation of radiographic evaluations are of utmost importance. Therefore, radiographic results have been incorporated into most definitions of success.

AIM: The present study aimed to observe the changes in crestal bone levels with thehelp of intraoral periapical radiographs using the grid to examine the changes in mesial and distal peri-implant alveolar bone up to 5 years.

METHODOLOGY: The study population was patients with dental implants who were treated in the Department of Prosthodontics, Babu Banarsi Das College of Dental Sciences, Lucknow. Patient were contacted by phone and asked to voluntarily participate by attending for meticulous follow up. The follow-up visits were normally at one week, 1, 3, 6 months after intervention and then recalled at 24, 36, 48 and 60 months for radiographic evaluation with standardized peri-apical radiograph with grid. The distance from the mesial and distal margins of the implant abutment junction to the first point of bone to implant contact (fBIC) was measured on mm scale.

RESULTS: Overall, a statistically significant difference in mean crestal bone loss was found among different follow ups. It was found that mean crestal bone height at 0

month & 3 month were found to be significantly lower than that at 6 month. It was further significantly lower than that at 24 months, which was further significantly lower than that at 36 months, 48 months and 60 months subsequently.

CONCLUSION: within the limitations of this study, it was found that the marginal bone levels decreased with the increasing intervals of time, but the loss was more during the first year of the implant placement.

Introduction

Tooth loss could be very not unusual place and it is able to occur because of disease and trauma; therefore, using dental implants to offer guide for substitute of lacking enamel has a protracted and multifaceted history Statistics supplied with the aid of using the American Association of Oral and Maxillofacial Surgeons display that 69% of adults a long time 35 to forty four have misplaced as a minimum one everlasting teeth to an accident, gum sickness, a failed root canal or teeth decay.

Furthermore, with the aid of using age 74, 26% of adults have misplaced all in their everlasting enamel. Therefore, using dental implants well-known shows that approximately 100,000-300,000 dental implants are located in line with year, which approximates the numbers of synthetic hip and knee joints located in line with year.[1]

The modalities to be had to deal with edentulism have modified over the years, from the fairly easy vulcanized dentures of the early twentieth century to the implant-retained buildings of today. Until properly into the ultimate century, maximum upgrades had been primarily based totally on cloth and/or procedural modifications. It is handiest within side the ultimate 3 or 4 many years that an opportunity to detachable prosthesis and stuck prosthesis has come to be to be had, reconstructions supported with the aid of using osseointegrated titanium implants.

It all began out whilst Professor Branemark used titanium chambers to analyze the anatomy and body structure of tissue injury. He found that the titanium chambers had been firmly connected to the bone and that they couldn't be eliminated from the bone as soon as it healed.

After this hazard observation, Branemark evolved a brand new idea of osseointegration which brought about dental implants. The use of titanium primarily based totally implants in human beings all started in 1965. Natural tooth, conventional

dental prosthesis, and dental implants all depend upon bone for assist. While the mechanisms of such assist differ, the tracking of bone stage upkeep affords precious facts approximately the durability of tooth and their replacements. Earlier, the assessment of implant achievement revolved across the mobility, peri-implant radiolucency, marginal bone loss and lack of contamination or soreness to the patient.

A take a look at even proposed an Implant Quotient to evaluate the long-time period achievement of the implant. Implant Quotient changed into derived with the aid of using referring to nice and poor elements of implant achievement.[2] Currently, implant achievement is evaluated with the aid of using lots of things in conjunction with the sooner ones.

Evaluation of circumferential bone loss round dental implants with the aid of using the use of periapical radiographs has been often utilized in habitual scientific exercise to save you remedy failure and make certain favorable long-time period prognosis. This technique of assessment has been debated, wherein sure authors have suggested bone re-absorption fees round dental implants: for example, Adell et al. suggested that radiographic crestal bone loss for the duration of the primary 12 months after abutment connection changed into 1.2 mm, with an average vertical bone loss of 0.2mm annually.[3]

Albrektsson proposed that a dental implant can be considered successful if the peri-implant crestal bone loss in the first year is<1.5 mm, and the ongoing periodic bone loss is <0.2 mm.[4] Also, findings from several other studies have indicated that the long- term results of endosseous implants primarily depend on preservation of bone support.

Thus, the conservation of osseo-integration and a stable borderline bone position is necessary for the success of a dental implant. The term implant success may be used to describe ideal clinical conditions. It should include a time period of at least 12 months for implants serving as prosthetic abutments. The term early implant success is suggested for a span of 1 to 3 times, intermediate implant success for 3 to 7 times, and long- term success for further than 7 times. The implant success rate should also include the associated prosthetic survival rate in a clinical report.

The borderline bone around the implant crestal region is generally a significant index of implant health. The position of the crestal bone may be measured from the crestal position of the implant at the original implant surgery.

The most common system (in the literature) to make bone loss after mending is by radiographic evaluation. Of course, conventional radiographics only cover the mesial or distal aspect of bone loss around the implant body. Several studies report monthly radiographic borderline bone loss after the first time of function in the range of 0 to0.2 mm. The borderline bone loss for the quality of health scale should include the first time. Although there are numerous different aspects that contribute to early bone loss, anyhow of the cause the overall quantum of bone loss may affect clinical criteria of success to failure. Clinical studies frequently report statistical average bone loss — not the range of bone loss observed in the study. However, the average bone loss in the study is 0, If 1 implant of 10 loses 5 mm of bone.5 mm; yet, the range of bone loss was 0 to 5 mm. Each implant should be covered as an independent unit when assessing bone loss for a clinical evaluation of success, survival, or failure.

Clinical compliances attained by probing or radiographic measures of0.1 mm for bone loss are driver sensitive and aren't dependable. Thus, the Pisa Consensus in this report

suggests that the clinical assessment for each implant observers borderline bone loss in supplements of1.0 mm. The bone loss dimension should be related to the original borderline bone position at implant insertion, rather than to a former dimension (e.g., 1 time previous). The most common system to assess the borderline bone loss is with a conventional periapical radiograph. Although this only determines the mesial and distal bone loss, it's a time- tested system.

Computer- supported image analysis and customized x-ray positioning bias may be superior styles of measuring bone loss, but aren't needed for the criteria established at this consensus. In lower than just a many decade, dental implants have moved from the external edge of dentistry to the mainstream. It serves as a first line of treatment for implant supported prosthesis and long lasting recuperation. Over numerous times, success has been estimated by the survival rate, radiographic crestal bone loss, prosthesis stability and the presence of peri-implant conditions. Evaluation of circumferential bone loss around dental implants by using periapical radiographs has been constantly used and insure favorable long- term prognostic. Beforehand clinical studies on dental implants observed a mean crestal bone loss ranging from0.9 to1.6 mm being during the first time of function, whereas a mean periodic bone loss ranging from0.05 to0.13 mm was reported in the follow-up ages. As a result, a mean periodic crestal bone loss (ABL) of lower than0.2 mm was recommended as one of the criteria for implant success. Albrektsson et al., proposed criteria for the assessment of implant success, to determine implant survival and clinical substantiation of successful osseo-integration, which is the most generally accepted criteria. For long- term results of endosseous implants, the conservation of osseo-integration and a stable borderline bone position is necessary for the success of a dental implant. Radiographic assessment of dental implants is a element of

preliminarily reported criteria for success. Routine assessment of crestal bone situations around a dental implant is essential to cover success. Correct operation and scientifically sound interpretation of radiographic evaluations are of utmost significance for long- term evaluation of oral implants. Thus, radiographic results have been incorporated into utmost delineations of success.

The aim of the present study was to observe the changes in crestal bone levels with the help of intraoral periapical radiographs using grid to examine the changes in mesial and distal peri-implant alveolar bone up-to 5 years.

The patients were recalled at 24, 36, 48 and 60 months for radiographic evaluation with standardized peri-apical radiograph with grid. Intraoral peri-apical radiographs were taken for all the implant sites of the selected patients. To compensate for magnification and image distortion errors, a lead grid with 1 square mm grid pattern was affixed on the sensor. The radiographs were standardized by using the standard long cone paralleling technique with film positioning device. The distance from the mesial and distal margins of the implant abutment junction to the first point of bone to implant contact (fBIC) was measured on mm scale. The implant health status and complications were also evaluated clinically.

Aims & Objectives

AIMS

1. The purpose of this study is to evaluate the dental implant prognosis.
2. To evaluate crestal bone levels radio-graphically for up-to 5 years after placement.

OBJECTIVES

1. To evaluate crestal bone height in two stage technique at the borderline, 60^{th} day and 90^{th} day.
2. To assess crestal bone levels mesially and distally for 24, 36, 48 and 60 months.
3. To compare bone levels of different time intervals.
4. To estimate the survival rate of prosthesis.

Review of Literature

Structured review of scientific publications in English literature related to the dissertation topic "**EVALUATION OF CRESTAL BONE LEVELS AFTER PLACEMENT OF DENTAL IMPLANTS AND A FOLLOW-UP UPTO 5 YEARS –A RADIOGRAPHIC PERSPECTIVE"** was done.

Alberktsson et al(1986) proposed the six criteria for determining the clinical success of endosseous dental implants and these criteria are suggested for use in clinical investigation on implants.

1. The mean vertical bone loss is less than 0.2mm annually after the first year of service.
2. No persistent pain, discomfort or infection is attributable to the implant.
3. The implant design does not preclude placement of a crown or prosthesis with an appearance that is satisfactory to the patients and dentist.
4. By these criteria, a success rate of 85% at the end of a 5-years observation period and 80% at the end of a 10 years period are minimum levels for success.

Alberktsson et al(1988)[5] reported a mandibular success rate of 99.1%., No implant was lost during a follow-up of up to five years in irradiated and grafted mandibles. Success rate in the maxilla was 84.9%. The conclusion drawn was that the osseointegrated implant, if inserted according to the guidelines of Brânemark, results in a very high degree of clinical success.

Henry PJ (1999)[6] presented some of the important issues pertinent to the long term success, survival, safety of these devices. The clinical acceptance of implants were

controlled initially by regulatory bodies, the dentist eventually must make a decision on the type of implant to be used in clinical practice. on the success rate of several implant systems have been accumulated, using short to medium term data while it is apparent that long term data comparing and contrasting the various advantages and disadvantages of different systems do not exist and adequate criteria applicable to the collective clinical experience needs to be considered. Emerging areas of application are dependent on rigourous and continuous improvements in implant hardware, surgical protocol development and rationalized osteo-promotive and site installation augmentation technology.

F. De Angelis et al (2017)[7]. The implant treatment options in patients with risk factors should be carefully evaluated. However it is concluded that the presence of a single risk factor may not imply an increase of failure risk. Among the analysed factors, the one that showed the worst results, when presenting alone, was bruxism, while the most dangerous association was between bruxism and lateral loads, resulting in failures both mechanical and biological. The association of bruxism and smoking represented a particularly risky circumstance with a success rate of 69.23%. This condition to be included among the absolute contraindications for implant treatment.

R. Adell, U. Lekholm, B. Rockler And P.I. Branemark(1981)[8]:- During 15 years (1965-1980), 2768 fixtures were installed in 410 edentulous jaws of 371 consecutive patients. The patients were provided with removable bridges and were examined at yearly controls. The surgical and prosthetic technique was developed and analysed over a pilot period of 5 years. In this group, about 130 jaws were provided with 895 fixtures, and of these 81% of the maxillary and 91% of the mandibular fixtures

remained stable, supporting bridges. In 89% of the maxillary and 100% of the mandibular cases, the bridges were continuously stable. During healing and the first year after the connection of the bridge, the mean value for the marginal bone loss was 1.5mm, concluding that only 0.1 mm was lost annually.

Anitua, Eduardo, Alkhraisat, Mohammad H., (1992)[9]:-evaluated the survival and baseline bone loss around short dental implants and assessed the influence of the anatomical location (mandible or maxilla) on these outcomes for a period of 15 years. It was found that the marginal bone loss was significantly higher in the maxilla than the mandible. The implant survival rate was 93.3%. Thus short dental implants could usually be indicated to support fixed partial prosthesis in the mandible and the maxilla. The marginal bone loss around the short dental implants are affected by the location in the arch.

Bergman, B (1983)[10]:- Evaluated the results of treatment with osseointegrated implants by a non –biased selection of 20 patients for the observation period of 4 months for one patient to 6 & 1/2 years for two patients. The mean observation period was 3 & 1/2 years. The patients were analysed according to periodontal and prosthetic parameters. The radiographic examinations were made and they were asked to subjectively evaluate their treatment. The mean gingival index according to Loe and Silness (1963) was 1.2, and the mean plaque index according to Silness and Loe (1964) was about 0.6 with the highest value of around 0.75. The mean pocket depth was 2.1 mm buccally and 3.7 mm lingually. 17 of 18 prostheses were stable, whereas in one patient the prosthesis exhibited slight mobility on one side. The radiographic examination failed to show any radiolucency between the bone tissue and the implant for 94 implants, a success rate of 97%. A radiolucent space was detected between

implant and bone in three implants. Therefore the National Institutes of Health Harvard Consensus Development Conference defined an implant as successful if the bone loss did not exceed one-third of its length, symptoms being completely absent, and if the implant was stable after a period of 5 years.

Blanes RJ, et al (2007)[11]. ITI dental implants in this study presented excellent long-term survival and success rates in the posterior jaw. These data seem to agree with the results of other authors evaluating the long-term performance of ITI dental implants. The mean ABL rate was lower than the proposed threshold acceptable for long-term implant success that is 0.2mm. However Hollow-cylinder implants seem to display a higher risk for crestal bone loss. The good clinical indicators of peri- implant bone loss were Recession depth and attachment levels.

Cochrane et al. (2009)[12] the most considerate and significant amount of bone loss occurred between the time of implant placement and definite prosthesis. One important factor that may induce bone loss in the weeks and months following implant placement may be interruption of the vascular supply to bony structures during preparartion of implant site. It results in acute inflammatory response with loss of bony trabecular and cortical bone around the implant, the net result being a loss of bone. As 2.84 – 1.63 mm of bone loss occurred between implant placement and the 5-year post-loading follow-up, 86% of the total mean bone loss over the period of 5 years was accounted for at the time of prosthesis placement. These same trends followed if the data were analyzed with regard to implant design (solid screw and hollow cylinder), type of restoration (single and multiple), and length of implant (8 to 10, 12, and 14 to 16 mm).

These data demonstrate that, in general, clinically significant marginal bone remodeling occurred between the time of implant placement and final prosthesis placement around one-stage non-submerged titanium implants with a titanium plasma–sprayed surface. Subsequent to that, bone loss observed was minimal around implants up to 5 years post loading. These results suggested that the factors influencing early healing around implants are significantly different from those affecting later marginal bone remodelling.

Bruschi GB et al. (2014)[13] Radiographic bone level changes were evaluated after delayed implant placement at medium term follow-up. After a mean follow-up of 9.71years, a survival rate of 97.76% was observed. At 1 year after implant placement, mean bone loss of -1.5 ± 0.62 mm was reported. At almost 3 years post- implant placement, a mean bone gain of +1.20 ±0.49 mm was seen, which was statistically significantly compared with 1 year. After this point, the bone levels remained stable; similar values were reported over time, with no significant differences. The three elements that were kept constant: keratinzed gingival thickness, implant axes perpendicular to the opposing occlusal surface and implants with a collar of 2 mm.

Chappuis V, et al. (2013)[14]. Long-term studies of 310 years are a crucial and significant milestones to get a better knowledge and understanding of potential factors causing implant failures or complications. The study investigated the long-term effects of titanium dental implants with a rough, microporous surface (titanium plasma sprayed [TPS]) and the associated biologic and technical complications in partially edentulous patients with fixed dental prostheses over a 20-year follow-up period. Ten implants in nine patients were lost during the observation period, resulting in an implant survival rate of 89.5%. Radiographically, 92% of the implants exhibited

crestal bone loss below 1 mm between the 1- and 20-year follow-up examinations. Only 8% yielded peri-implant bone loss of 1 mm and none of them exhibited severe bone loss of more than 1.8 mm. During the observation period, 19 implants (20%) experienced a biologic complication with suppuration. Of these 19 implants, 13 implants (13.7%) had been treated and were successfully maintained over the 20-year follow-up period.

Therefore, the 20-year implant success rate was 75.8 or 89.5% depending on the success criteria. In 32% of the cases technical complications were observed.

Raes et al.(2011)[15] The comparisons were made of interproximal bone-level measurements on periapical radiographs and cone beam computerized tomography around a selection of implants and described a highly significant ($P < 0.001$) disparity based on a weak correlation ($R = 0.325$, $P = 0.019$) and the fact that agreement within 0.2 mm deviation was found in only 42% of the sites. A mean difference of 0.47 mm (range 0.47 to 3.13) was observed between periapical radiographs and cone beam computerized tomography. It is usually accepted that computed tomography is more accurate than orthopantomography for preoperative planning. The disadvantage of three dimensional scanning is the higher radiation dose received by the patient compared with the two dimensional imaging technique. Therefore, orthopantomograph is the preferred radiographic technique when greater than five periapical radiographs are required.

Pepelassiet al.(1997)[16]. evaluated the bone destruction in periodontal defects during surgery and compared the results based on periapical radiographs and orthopantomographs. Overall, 4992 surfaces were measured on periapical radiographs. Seventy-nine per cent of the sites had a defect depth within 1 mm close

to the reality, 91% and 96% was respectively within 2 or 3 mm nearby to the real defect size. On orthopantomographs, 89%, 97% and 98% of the sites were correctly assessed within 1, 2 or 3 mm, respectively. On an average, the periapical radiographs undermined the bone loss by only 0.17% in comparison with 6.4% in the maxilla or 7.6% in the mandible using orthopantomographs. The authors concluded that the radiographic detection ability of small (0-2 or 3-4 mm) defects is insignificant for both periapical radiographs and orthopantomographs. Hence, radiographs underscore the true defect when these are small. On the other hand, they overscore large defects. Orthopantomographs and periapical radiographs agreed best in sites with severe destruction but not in sites with only slight destruction. For small defect periapical radiographs are 4.7 times more effective in measuring the true defect than orthopantomograms. **Heitz-Mayfield LJ(2008)[17]**: Experimental and clinical studies have recognized various diagnostic criteria including probing parameters, radiographic assessment and peri-implant crevicular fluid and saliva analyses. Cross-sectional analyses have investigated potential risk indicators for peri-implant disease including poor oral hygiene, smoking, history of periodontitis, diabetes, genetic traits, alcohol consumption and implant surface. There is proof that probing using a light force (0.25 N) does not damage the peri-implant tissues and that bleeding on probing (BOP) indicates presence of inflammation in the peri-implant mucosa. The probing depth, the presence of BOP, and suppuration should be under scrutiny regularly for the diagnosis of peri-implant diseases. To evaluate supporting bone levels around implants radiographs are required. The review identified strong evidence that poor oral hygiene, a history of periodontitis and cigarette smoking, are potential risk indicators for peri-implant disease. Future scope of prospective studies are required to confirm these factors as true risk factors.

Kullman L et al. (2007)[18]: The ability of two radiographic methods were assessed that is intraoral and periapical radiographic methods. It was found that agreement rate was high. The results of this study, in which 21 patients were evaluated by 2 clinicians, demonstrate that panoramic radiographs show bone- to- thread contact as reliably as intraoral radiographs. However, neither method provided excellent inter- or intraexaminer reliability in radiographic assessment.

Branemarket al.(1985)[19] In general, after the abutment connection intraoral radiographs are taken, in order to control that the abutments are properly positioned. On the basis of measurements on these radiographs, the baseline value for future marginal bone changes can be established. Standardized periapical radiographs should be taken at regular follow-up intervals to detect peri-fixtural radiolucency and/or progressive marginal bone loss or ‘‘saucerization’’.

Hansson Bo(1977)[20]. There can be 2 well-distinct radiographic pictures: a thin peri-fixtural radiolucency surfacing the entire implant, concluding the absence of a direct bone-implant contact and possibly a loss of stability, and an increased marginal bone loss. In the first case, the implant is usually found mobile when tested, whereas in the latter, fixture can be stable. It should be considered that an abnormal rate of marginal bone loss can also be a sign of a mechanical failure (fracture of the implant).Since the distinction between these 2 radiographic pictures is not always clear, when a suspected peri-fixtural radiolucency or excessive marginal bone loss is observed, it is advised to remove the prosthetic construction and check the implants for stability. Clinically detectable mobility after bridge removal can authenticate the presumptive radiographic diagnosis of implant.

Bahat., O(2000)[21]:- evaluated Brånemark System implants placed in posterior maxillae that have been restored with fixed partial ceramometal restorations and followed for as long as 12 years after loading. The accruing success rate is therefore 94.4% at 5 to 6 years and 93.4% after 10 years. The quality and quantity of bone appeared to have insignificant influence on the success rate. Surgical techniques are particularly important to the success of osseointegrated implants placed in the posterior maxilla. With careful surgical planning and execution, a success rate of approximately 95% at 5 years can be achieved.

Dvorak, G., Fügl, A., Watzek, G., Tangl, S., Pokorny, P. and Gruber, R. (2012)[22]: fifty ovariectomized rats; were divided into three groups, which were fed 8 days of vitamin D-free diet, 6 weeks of vitamin D-free diet, and then switched to a standard diet containing 2400 IU/kg of vitamin D, and the control group received only a standard diet. Implant placement showed that the vitamin D deficiency had a negative effect on cortical peri-implant bone formation in ovariectomized rats and this could be recompensated by vitamin D supplementation. This study is of particular significance in that it provides the first point of view of the potential effect of vitamin D supplementation on implant dentistry

Mangano, F., Mortellaro, C., Mangano, N., & Mangano, C (2016)[23], they inspected the correlation between early dental implant failure and low serum levels of vitamin D. Patients treated with dental implants in a single centre, in the period 2003–2015, were considered for enrollment in this study. The main result was early implant failure. The influence of patient-related variables on implant survival was calculated using the Chi-square test. 822 patients treated with 1625 implants were selected for this study; 27 early failures (3.2%) were recorded. There was no link between gender,

age, smoking, history of periodontitis, and an increased incidence of early failures. Statistical analysis reported 9 early failures (2.2%) in patients with serum levels of vitamin D > 30 ng/mL, 16 early failures (3.9%) in patients with levels between 10 and 30 ng/mL, and 2 early failures (9.0%) in patients with levels.

Moraschini et al(2014)[24]. To allow the survival and success of implants to be examined appropriately, a minimum of 5 years of follow-up is necessary. It revealed a mean survival rate of 94.6% (SD 5.97%) for a total of 7711 implants in 23 studies, with a follow-up period of up to 20 years (mean follow-up of 13.4 years). The studies that conducted the longest period of follow-up, 20 years, presented a mean survival rate of 91.2% (SD 12%). In 2002, a systematic review analyzing longitudinal studies of 5 years, and observed an implant survival rate of 97.5% up to the second stage of surgery. In conclusion, the analysis of the studies included in this review, with a follow-up period of up to 20 years, displayed significant high survival rates (cumulative mean 94.6%, SD 5.97%). Approximately 70% of the implant losses occurred after placement of the abutment and prosthetic loading, thereby demonstrating that a higher number of failures occur after implants are in function. Taking into consideration the disparate outcome measures employed to assess dental implant performance and within the limitations of this systematic review, we may affirm that Osseo integrated implants are safe and present high survival rates and minimal marginal bone resorption in the long term.

Jaisika Rajpal, Krishna K Gupta, Pradeep Tandon, Amitabh Srivastava, Chetan Chandra(2016)[25]: conducted a study entitled " Assessment of hard and soft tissue changes around Implants: A clinico-radiographic *in vivo* study". The scope of the present study was to analyze the hard and soft tissue changes around two-stage

implant both radiographically and clinically to assess the success of implants. Seven patients with 10 dental implants were examined clinically for 6 months after prosthodontic treatment. Plaque index and health indices of soft tissue including pocket depth, mobility, bleeding index, calculus and gingival index were measured. Marginal crestal bone loss and peri-implant radiolucency were checked radiographically. The criteria both subjective and objective were used to evaluate the success of the implant process. The necessary statistical analysis was performed for radiographic and clinical evaluation methods. The values of all clinical criteria under study had no considerate changes from baseline to 6 months. The vertical crestal bone loss on the mesial and distal side was within the normal range of bone loss given by Brånemark. There was no mobility and no peri-implant radiolucency around any of the implants. The study clearly demonstrated that in a group of patients with no periodontal disease the survival rate of two-stage, countersunk, submerged implants in the edentulous sites is 100% during the follow-up period of 6 months.

Simonis et al(2010)[26]. conducted a study entitled "Long-term implant survival and success: which is a 10–16-year follow-up of non-submerged dental implants. The scope of the present study was to evaluate the long-term results of dental implants using implant survival and implant success as outcome variables. The long-term implant cumulative survival rate up to 16 years was 82.94%. The prevalence of biological complications was 16.94% and the technical complications was 31.09%. The cumulative complication rate after an observation period of 10–16 years was 48.03%, which meant that substantial amounts of chair time were necessary after implant placement. The majority of implant losses and biological complications were concentrated in a relatively small number of patients. Despite a high long-term survival rate, biological and technical complications were more frequent. Patients

with a history of periodontitis may have lower implant survival and were more prone to biological complications as peri-implant mucositis and peri-implantitis.

V. Moraschini, L. A. da C. Poubel, V. F. Ferreira, E. dos S. P. Barboza(2014)[27]: The aim of this systematic review was to evaluate the survival and success rates of osseointegrated implants in longitudinal studies that conducted a follow-up of at least 10 years. There were two reviewers who analyzed the titles, abstracts, and complete articles, prioritizing studies of the randomized clinical trial type. A total of 23 articles were included in this study. Ten prospective studies, nine retrospective studies, and four randomized clinical trials, which evaluated 7711 implants, were selected. The mean follow-up time of the studies included was 13.4 years. All of the studies reported survival rates and mean marginal bone resorption values, with cumulative mean values of 94.6% and 1.3 mm, respectively. Fourteen studies related success rates. Taking into consideration the disparate outcome measures employed to assess dental implant performance and within the limitations of this systematic review, we may affirm that osseointegrated implants are safe and present high survival rates and minimal marginal bone resorption in the long term.

Fritz, M E (1999)[28]:-two-stage dental implants are successful, showing a confidence interval of over 90%. It also appears that the mandibular implants are more successful than maxillary implants.

Anitua., E et al (2018)[29]:-evaluated the survival and marginal bone loss around short dental implants and assessed the influence of the anatomical location (mandible or maxilla) on these outcomes for up to 15 years. The marginal bone loss is higher in the maxilla than the mandible. The survival rate of implant was 93.3%. Short dental implants could be indicated to support fixed partial prosthesis in the mandible and the

maxilla. Implant position may affect the marginal bone loss around the short dental implants.

Kim et al.(2008)[30] described that 47–82% of the subjects showed about 10% differences in root length measured on either periapicals or orthopantomographs. Depending on the tooth to be evaluated there is a difference between bone-level measurements on periapical radiographs and orthopantomographs. The radiographs do not detect the early periodontal lesions, and the true amount of periodontal destruction in more advanced disease is generally undervalued.

Albrektsson T et al. (1987)[31] Periapical radiography represents a generally accepted method to assess the long-term evaluation of interproximal crestal bone changes of osseointegrated implants; however, the sensitivity for detecting small changes in bone level is low. Although the optical resolution of standard radiographs is too small to detect fibrous encapsulation or osseointegration (7), ongoing bone loss over time can be an indication of peri-implant infection. Therefore, radiographic results have been incorporated into most definitions of success.

Lang NP et al.(2011)[32] According to the consensus meeting of the European Federation of Periodontology (59), a radiograph should be obtained at the time of prosthetic loading to determine alveolar bone levels after physiologic remodeling, and peri-implant probing should also be performed. The recorded baseline data should be the reference from which the development of peri-implant disease can be recognized in subsequent examinations. The choice to make the time of loading the baseline is probably based mostly on historical dogmas. Indeed, a large majority of clinical studies were performed using a delayed loaded approach. One should understand,

however, that the time of loading is dependent on the surgical and prosthetic treatment protocols. When baseline radiographs are taken after prosthesis placement, the initial bone remodeling may already have taken place and consequently the measured bone loss excludes the bone lost during the initial remodeling.

Zeckner et al.[33] Stable peri-implant bone level is an important indicator of implant health and can be easily verified by radiographs provided imaging errors related to beam geometry and resultant asymmetric distortions have been minimized.

Pikner et al.[34] studied radiographs of 640 patients, representing 3462 machined Branemark implants with at least 5 years of follow-up. The mean bone loss after 5 years was 0.8 mm and insignificant changes were reported thereafter. The prevalence of implants with bone level loss (measured from abutment– implant junction) above 3 mm was 2.8% at the time of prosthesis insertion but 5.6%, 10.8%, 15.2%, 17.2% and 23.5% after, respectively, 1, 5, 10, 15 and 20 years. The mean bone level values, however, did not show a significant change, despite an increasing number of implants losing bone over time.

Misch et al.[35] In 2008, the Pisa Consensus Conference came to the same conclusion, stating that each implant should be monitored as an individual unit when assessing bone loss for evaluation of success, survival or failure.

Material & Methodology

The study was conducted on the patients visiting the Department of Prosthodontics, Babu Banarsi Das College of Dental Sciences, Lucknow, Uttar Pradesh, to evaluate radio-graphically crestal bone levels for up-to 5 years after placement and to assess crestal bone levels mesially and distally for 24, 36, 48 and 60 months.

The study population was patients with dental implants who were treated in the Department of Prosthodontics, Babu Banarsi Das College of Dental Sciences, Lucknow.

In this randomized study, a total of 25 implants were assessed radiographically.

ELIGIBILITY CRITERIA:

Inclusion criteria:

1. Male and female patients aged 25 to 65 years.
2. Patients restored with fixed partial ceramo-metal reconstructions.
3. Patients conscious of oral hygiene and willing to undergo restoration with dental implant.
4. Partially edentulous patients.
5. Patients with a completely healed socket.
6. Healthy patients with no systemic diseases to ensure uneventful healing and osseointegration of implants.
7. Patients with good periodontal health in the remaining dentition.
8. Patients with an adequate amount of bone volume and bone quality for implant placement.

Exclusion Criteria:-

1. Patients who are not willing to enroll in the study.
2. Patients with any known systemic diseases/ conditions and/ or medications to interfere with wound healing or minor surgical procedures..
3. Patients with allergy to any drug or materials used in the study.
4. History of alcoholism or drug abuse within the past 5 years.
5. Severe wear with an etiology of bruxism and clenching habits.
6. Patients currently undergoing chemotherapy or patient having a history of radiation treatment to the head and neck.
7. Patients unable to maintain adequate oral hygiene.

METHODOLOGY

This is a retrospective study and the study population was patients with dental implants who were treated in the Department of Prosthodontics, Babu Banarsi Das College of Dental Sciences, Lucknow. Patient were contacted by phone and asked to voluntarily participate by attending for meticulous follow up. They were provided with a written consent form and a written explanation regarding the nature of study, treatment procedures and the benefits of the follow-up protocols. In this study case selection criteria were patients to be older than 25 years at the time of surgery, the insertion of at least one dental implant in either maxilla or mandible.

VARIABLES

The patient's demographic data (age and sex) were obtained.

The predictor variable was the crestal bone loss at the baseline measured radiographically. The primary outcome was the implant survival, defined as whether the implant is still physically in the mouth or has been removed.

Four classes of patients were considered in the analysis of serum levels of vitamin D: severely deficient patients (serum vitamin D <10 ng/mL), patients with low levels (serum vitamin D 10–30 ng/mL)with and without supplementation, and patients with optimal levels of vitamin D (serum vitamin D >30 ng/mL).

The secondary outcomes were: 1) the implant success rate, 2) the anatomical location (mandible or maxilla, 3) smoking habits, 4) the survival of the dental prosthesis defined as the first definitive prosthesis is still physically in the mouth at the last visit.

ARMAMENTARIUM

Materials and instruments used during the course of this study.

A. Equipments
    - Implant kit†
    - Physiodispensor£
    - Periapical radiograph machine©
    - Panoramic radiograph machine®
    - Film positioning device€
    - IOPA Grid¥

B. Materials

- Intraoral Periapical Radiographic films (size 21X41mm)◦
- Panoramic dental films (size 15X30 cm)y˝
- Chromatic Alginate Impression Material±
- Type III Dental Stone†
- Clear self cure acrylic resinµ
- Lidocaine topical aerosol≠
- 2% Xylocaine with adrenaline(1:80,000)Ψ
- Providone Iodine Solution (5 w/v)Ł
- Saline (sodium chloride, I.P. 0.9% w/v)Ÿ˚
- Suture materialϕ
- Addition Silicone rubber base impression materialϭ
- Type IV Die stoneŦ
- Type I (luting) Glass Ionomer cement☃

C. Miscellaneous instruments needed during the surgical and prosthetic procedures.

D. LABORARTORY INVESTIGATION

Included routine blood examination along with HBsAg, HIV, HbA1c, Vitamin D and random blood sugar.

E. RADIOGRAPHIC EVALUATION

It plays an important role in developing patient's treatment plan and objective comparative measurements to be made over time. All the patients are subjected to radiographic examination of the implant site using the following radiographs.

- Orthopantamograph

- Intraoral periapical radiograph with grid using paralleling cone technique with positioning device.

PANORAMIC RADIOGRAPHS: A screening procedure for pre implant alveolar bone dimensional assessment of the implant site and decide the length of the implant to be used based on regional anatomy.

INTRAORAL PERI-APICAL RADIOGRAPHS:

- Pre-operative
- Immediately post- operative
- Two months after implant placement
- Three months after implant placement
- Twenty four months after implant placement
- Thirty six months after implant placement
- Forty eight months after implant placement
- Sixty months after implant placement

DATA COLLECTION METHODS

Dental implants were followed clinically and radio-graphically to identify any sign of implant failure. The implant/prosthesis survival was positively evaluated if the implant/prosthesis was present at the last follow-up. The measurement of the crestal bone loss was performed using intra-oral films with grids. The bone level recorded just after the placement of the provisional prosthesis served as a reference for the measurement of the crestal bone levels. Before surgery, patients underwent a routine phase I periodontal treatment before implant surgery. Patients with periodontal

pockets were subjected to pocket elimination or reduction surgeries. The treatment plan was set after clinical examination, study of the diagnostic wax-up, photographs, ridge mapping, standardized radiographs with millimeter grids(X-Ray mesh) and cone-beam computerized tomography (CBCT) scans. Patients received oral antiobiotic prophylaxis one hour before the surgical procedure. The oral cavity was prepared with 5% providone iodine solution.

After the reflection of a full-thickness flap mucoperiosteal flap, implant sites were marked by using series of drills precisely and incrementally as per the instructions and site requirement using profuse irrigation working at 1000-1500 rpm.

For placing the dental implant, the torque was set >30 N cm and <45 N cm and the implants were finally seated manually by a calibrated torque wrench followed by placement of cover screw.

The implants evaluated in this study were threaded root form implants.

None of the implants were immediately loaded. Abutment placement was done after 3 months.

The definitive prosthesis was placed after 6-9 months of progressive loading with a provisional prosthesis.

The occlusal scheme was the maximum inter-cuspation with mutual protection.

RADIOGRAPHIC PARAMETERS

The follow-up visits were normally at one week, 1, 3, 6 months after intervention and then recalled at 24, 36, 48 and 60 months for radiographic evaluation with standardized peri-apical radiograph with grid.

Intraoral peri-apical radiographs were taken for all the implant sites of the selected patients. To compensate for magnification and image distortion errors, a lead grid with 1 square mm grid pattern was affixed on the sensor. The radiographs were standardized by using the standard long cone paralleling technique with film positioning device.

The distance from the mesial and distal margins of the implant abutment junction to the first point of bone to implant contact (fBIC) was measured on mm scale. The implant health status and complications were also evaluated clinically.

EVALUATION PARAMETERS

All the parameters/values/data were recorded by the same examiner to avoid inter-examiner variability in the standard proforma drawn for the study and were subjected to statistical analysis.

ABBREVIATIONS

£ NSK Surgic AP, Japan

†Adin Implant Private Ltd

© Planmeca Prostyle intraoral X-ray machine

®Planmeca Pm 2002 Cc Proline

€ Dentsply India

¥ X-ray mesh gauge, Dentech Corporattion, Japan

◦Kodak @ Ekta speedfilm

Ƴ Kodak T-MAT GIRA

±DPI, Dental Products, Mumbai, India

† Kalrock, Kalabhai Karlson Private Ltd, Mumbai, India

µ Dental Products of India, Gurgaon India

≠ Nummit Spray

Ψ Xicaine ICPA health products Ltd. India

ƀ Wockhardt ltd., India

Ÿ Wockhardt ltd., India

Φ Ethicon, Johnson & Johnson Ltd. India

ϭ Dentsply, India

ŧ Kalrock, Kalabhai Karlson Private Ltd, Mumbai, India

ϩ Fuji I, GC, America

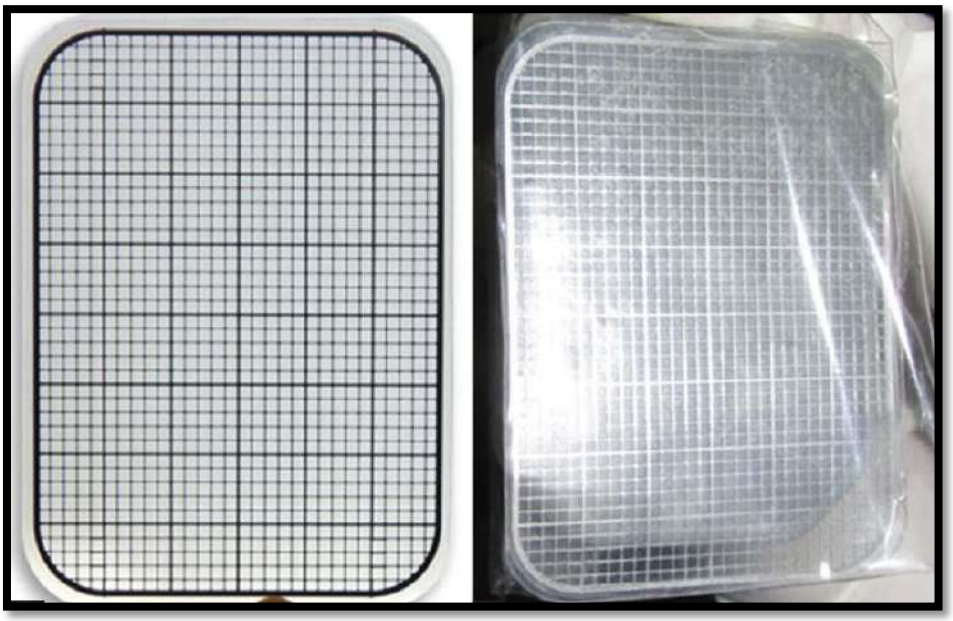
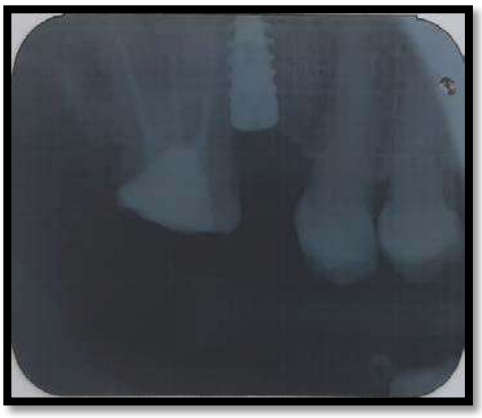
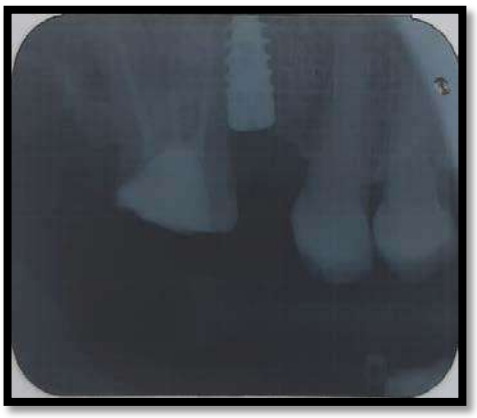


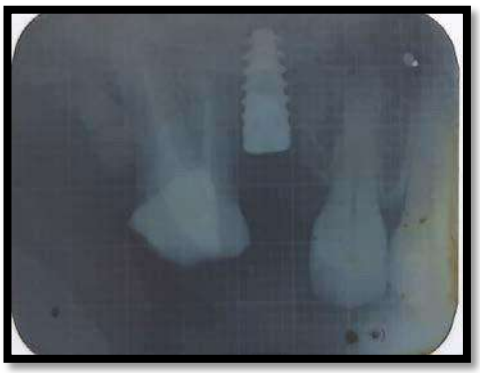
FIGURE 1: IOPA WITH GRID



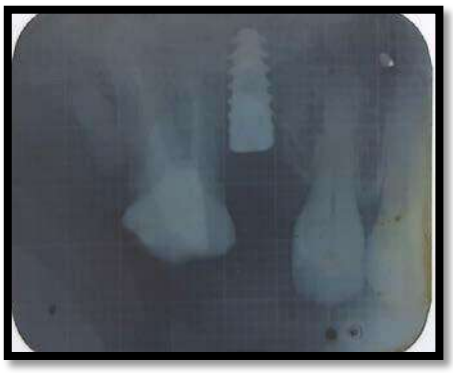
At Baseline



At 3 months

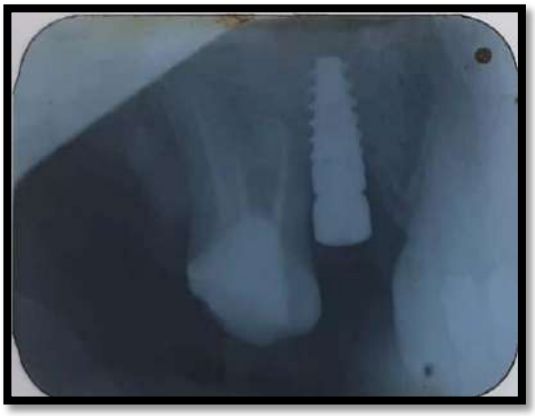


At 6 months

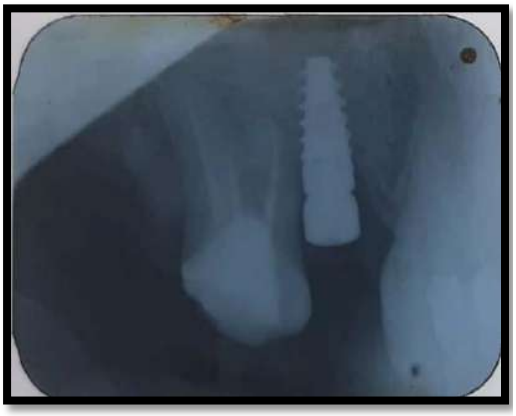


At 24 months

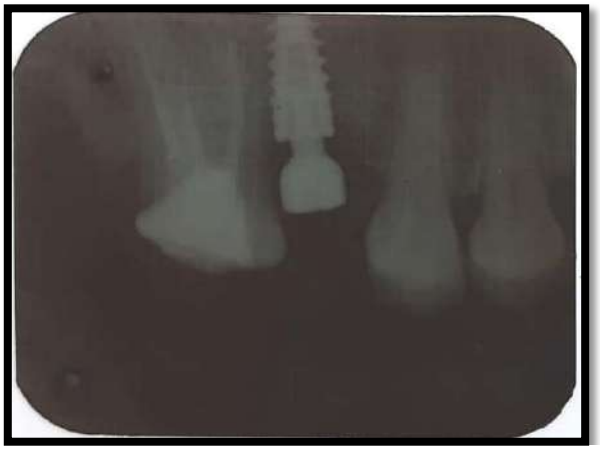
FIGURE 2: IOPA'S AT BASELINE, 3 MONTHS, 6 MONTHS AND 24 MONTHS



At 36 months



At 48 months



At 60 months

FIGURE 3: IOPA'S AT 36 MONTHS, 48 MONTHS AND 60 MONTHS

Results & Observations

The present study evaluates the mean crestal bone levels at the mesial and distal side. They were assessed at day 60, day 90, 24 months, 36 months, 48 months and 60 months and measured in millimetre (mm). The objective of the study was to measure the outcome over different time periods for up-to 5 years.

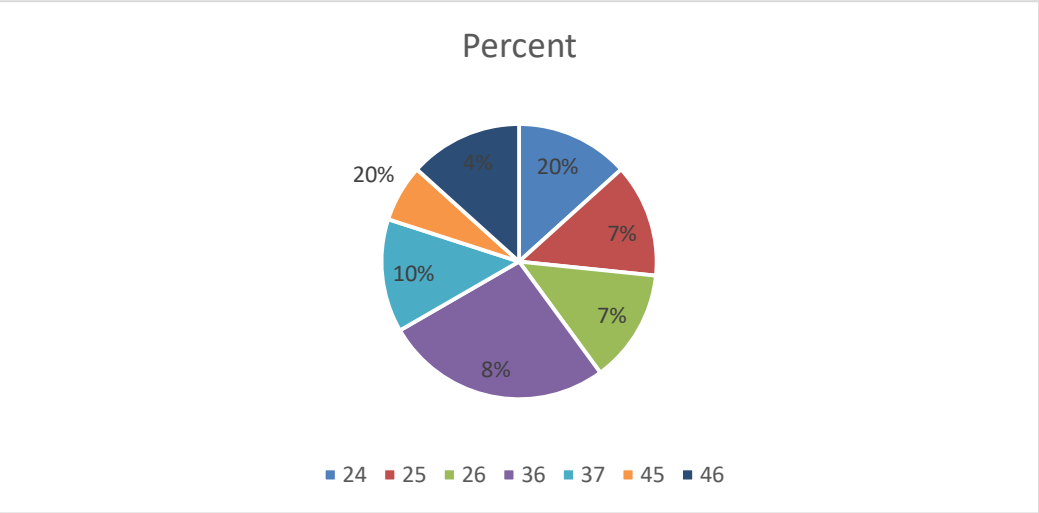
OBSERVATIONS:

The study included 15 samples out of which 9 samples were the mandibular teeth which is about 60% and 6 samples were the maxillary teeth which is the 40%.

TABLE 1:

Tooth type			
		Frequency	Percent
Tooth notation	24	10	20%
	25	7	14%
	26	7	14%
	36	4	8%
	37	10	20%
	45	10	20%
	46	2	4%
	Total	50	100.0%

GRAPH 1:



OUTCOME MEASURES- CRESTAL BONE LEVELS

1. MESIAL SIDE

The crestal bone loss (mm) at mesial over the periods is summarized in Table 2 and also depicted in Graph 2.

Intragroup comparison of mean crestal bone height on mesial side, at different follow up points was done using Friedman test. Overall, a statistically significant difference in mean crestal bone height at mesial side was found among different follow ups.

Further Post hoc pairwise comparison of mean crestal bone height on mesial side was done using Wilcoxon test. It was found that mean crestal bone height at 0 month & 3 month were found to be significantly lower than that at 6 month which was further significantly lower than that at 24 months, which was further

significantly lower than that at 36 months, which was further significantly lower than that at 48 months, which was further significantly lower than that at 60 months.

TABLE 2:

Crestal bone height at Mesial side					
	N	Minimum	Maximum	Mean	Std. Deviation
At 0 month	50	0	0	.00	.000
At 3 month	50	0	0	.00	.000
At 6 month	50	.1	.1	.100	.0000
At 24 month	50	.1	.2	.140	.0507
At 36 month	50	.1	.2	.167	.0488
At 48 month	50	.2	.3	.233	.0488
At 60 month	50	.2	.4	.293	.0704
P value	<0.001, S				

GRAPH 2:

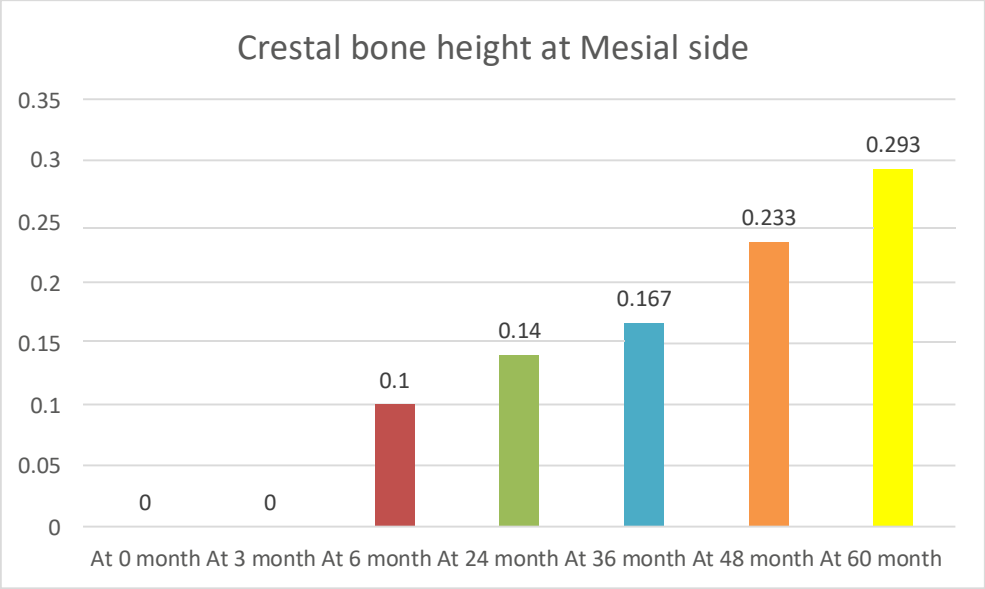


TABLE 3:

P values of post hoc pairwise comparison of crestal height at mesial side using Wilcoxon test							
	0 month	3 month	6 month	24 month	36 month	48 month	60 month
0 month	-	1.000	<0.001	<0.001	<0.001	<0.001	0.001
3 month	1.000	-	<0.001	<0.001	<0.001	<0.001	0.001
6 month	<0.001	<0.001	-	0.014	0.002	<0.001	0.001
24 month	<0.001	<0.001	0.014	-	0.046	<0.001	<0.001
36 month	<0.001	<0.001	0.002	0.046	-	0.001	0.001
48 month	<0.001	<0.001	<0.001	<0.001	0.001	-	0.003
60 month	0.001	0.001	0.001	<0.001	0.001	0.003	-

2. DISTAL SIDE

The crestal bone loss (mm) at mesial over the periods is summarized in Table 4 and also depicted in Graph 3.

Intragroup comparison of mean crestal bone height on distal side, at different follow up points was done using Friedman test. Overall, a statistically significant difference in mean crestal bone height at distal side was found among different follow ups.

Post hoc pairwise comparison of mean crestal bone height on distal side was done using Wilcoxon test. It was found that mean crestal bone height at 0 month was found to be significantly lower than that 3 month which was further found to be

significantly lower than that at 6 month which was further significantly lower than that at 24 months& 36 months, which were further significantly lower than that at 48 months, which was further significantly lower than that at 60 months. No statistically significant difference could be found in the mean crestal bone height at 24 months & 36 months.

TABLE 4:

Crestal bone height at Distal side					
	N	Minimum	Maximum	Mean	Std. Deviation
At 0 month	50	0	0	.00	.000
At 3 month	50	.0	.1	.040	.0507
At 6 month	50	.1	.2	.113	.0352
At 24 month	50	.1	.2	.160	.0507
At 36 month	50	.1	.2	.160	.0507
At 48 month	50	.2	.3	.213	.0352
At 60 month	50	.2	.4	.300	.0535
P value	<0.001, S				

GRAPH 3:

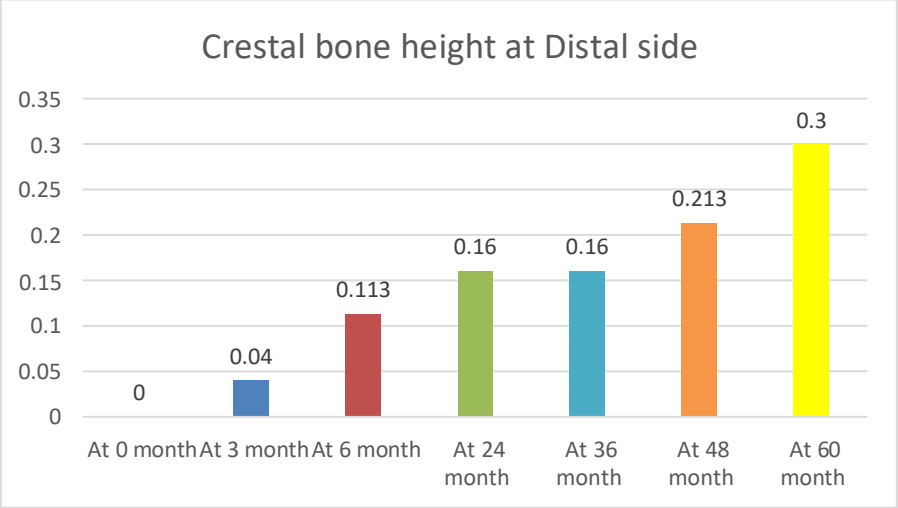


TABLE 5:

P values of post hoc pairwise comparison of crestal height at distal side using Wilcoxon test							
	0 month	3 month	6 month	24 month	36 month	48 month	60 month
0 month	-	0.014	<0.001	<0.001	<0.001	<0.001	<0.001
3 month	0.014	-	<0.001	<0.001	<0.001	<0.001	0.001
6 month	<0.001	<0.001	-	0.008	0.008	<0.001	<0.001
24 month	<0.001	<0.001	0.008	-	1.000	0.005	<0.001
36 month	<0.001	<0.001	0.008	1.000	-	0.005	<0.001
48 month	<0.001	<0.001	<0.001	0.005	0.005	-	<0.001
60 month	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	-

3. OVERALL CRESTAL BONE LOSS

Intragroup comparison of overall mean crestal bone loss, at different follow up points was done using Friedman test. Overall, a statistically significant difference in mean crestal bone loss was found among different follow ups.

TABLE 6:

Overall Crestal bone loss					
	N	Minimum	Maximum	Mean	Std. Deviation
At 0 month	50	.00	.00	.0000	.00000
At 3 month	50	.00	.05	.0200	.02535
At 6 month	50	.10	.15	.1067	.01759
At 24 month	50	.10	.20	.1500	.02673
At 36 month	50	.10	.20	.1633	.03519
At 48 month	50	.20	.30	.2233	.03200
At 60 month	50	.25	.40	.2967	.04419
P value	<0.001, S				

GRAPH 4:

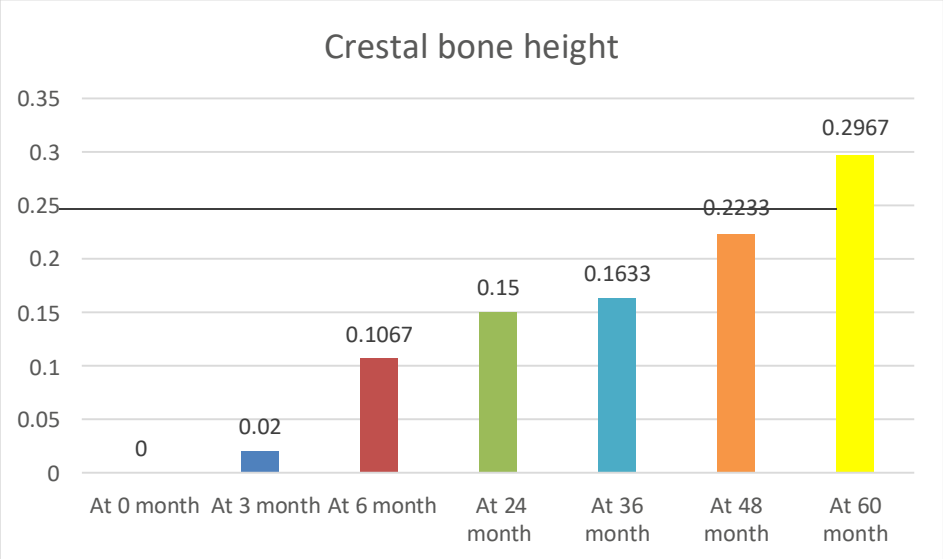


TABLE 7:

P values of post hoc pairwise comparison of crestal height overall on both mesial and distal side using Wilcoxon test							
	0 month	3 month	6 month	24 month	36 month	48 month	60 month
0 month	-	0.014	<0.001	<0.001	0.001	<0.001	0.001
3 month	0.014	-	<0.001	<0.001	<0.001	0.001	0.001
6 month	<0.001	<0.001	-	0.001	0.002	<0.001	0.001
24 month	<0.001	<0.001	0.001	-	0.046	0.001	0.001
36 month	0.001	<0.001	0.002	0.046	-	0.003	0.001
48 month	<0.001	0.001	<0.001	0.001	0.003	-	0.001
60 month	0.001	0.001	0.001	0.001	0.001	0.001	-

Discussion

To successfully achieve function and esthetics for replacement of missing teeth dental implants have emerged as a remarkable progress in the field of dentistry. Maintenance of healthy host tissue around is the major goal of these restorations. The most relevant crtiteria is the evaluation of the mesial and distal heights of bone from a fixed point on the implant which is a non-invasive way to assess bone remodeling around implants longitudinally.

The specific aims of this study were focused on evaluating retrospectively, with a long-term follow- up of up-to 5 years.

Albrektsson T et al(1986)[5] delineated various criteria for the success of oral implants. The most important and significant of all is peri-implant bone levels. Various different parameters influences implant integration, initial bone loss and bone loss after integration and prosthetic rehabilitation. Therefore, an overall bone loss that includes both initial and final bone changes is a dominant parameter for implant evaluation.

Thus, the present study was designed to evaluate and correlate the radiographic crestal bone loss at different time intervals. The study included patients with dental implants who were treated in the Department of Prosthodontics, Babu Banarsi Das College of Dental Sciences, Lucknow. Patient were contacted by phone and asked to voluntarily participate by attending for meticulous follow up.

They were provided with a written consent form and a written explanation regarding the nature of study, treatment procedures and the benefits of the follow-up protocols. In this study case selection criteria were patients to be older than 25 years at the time of surgery, the insertion of at least one dental implant in either maxilla or mandible.

The measurement of the crestal bone loss was performed using intra-oral films with grids. The bone level recorded just after the placement of the provisional prosthesis served as a reference for the measurement of the crestal bone levels.

The study protocol was approved by the institutional ethical committee of Babu Banarsi Das College of Dental Sciences.

Subjects restored with fixed partial ceramo-metal reconstructions and aged between 25-65 years were included in this study. Subjects with any known systemic diseases/ conditions and/ or medications which otherwise may interfere with the results of the study as well as patients with known allergy to any drug and/or material used in this study were excluded. Similarly current smokers, subjects with para-functional habits, history of alcoholism or drug abuse within the past 5 years were also not considered. Studies have reported the failure rate of implants in smokers being more than twice that in non-smokers. Levin et al in his study stated that present smokers demonstrated higher marginal bone loss during all time intervals than ex-smokers and both indicated greater marginal bone loss than non-smokers.[36]

The mechanism of action is the direct cutaneous vasoconstrictive action of nicotine, the increased levels of fibrinogen, hemoglobin and blood viscosity, excessive levels of carboxyhemoglobin in blood, compromised polymorphonuclear neutrophil (PMN) leukocyte function, including the increased platelet adhesiveness. They have all been hypothesized to be the mechanisms by which smoking compromises wound healing.[37]

Bain and Moy, in 1993, evaluated the effects of smoking on the failure rate of dental implants. They compared the results between dental implants placed in smokers *vs* those placed in non-smokers. The overall failure rate of that was found to be consistent with other studies was 5.92%; however, when the patients were

subdivided into smokers and nonsmokers, it was found that significantly greater percentage of failures occurred in smokers (11.28%) than in nonsmokers (4.76%) (P<0.001). Through the findings of this study, for the first time smoking was identified as a major factor in implant failure. Subsequently, a few other studies also implicated smoking as a major cause of implant failure.[38]

Various other studies have also determined tobacco use as one of the statistically significant (P=0.004) factors associated with an increased risk of implant failure, with a hazard ratio of 4.3, i.e., the risk of implant failure in smokers is 4.3 times that in non-smokers.[39]

Literature have reported that the failure rate of implants in smokers is twice that in non-smokers.

Generally, smoking appears to have a large impact on maxillary implants than on mandibular implants. DeBruyn and Collaert, in a retrospective study of over 200 implants, found that prior to loading, there was a difference in the success rates in smokers between maxillary and mandibular implants. Maxillary success rates were adversely affected than that in mandible were not. Also, a study by Haas et al., found peri-implantitis as being significantly worse in the maxilla in smokers than in nonsmokers, but this relationship was not found in the mandible.[40]

Intraoral periapical radiograps(IOPA), Orthopantomographs (OPG), conventional topography, and Computerized tomographic scanning are the most routinely recommended techniques for the radiographic assessment of the implants. They can be performed quickly and at low cost, and they also allow objective comparative measurements to be made over time.

To enable an accurate measurement on a radiograph, radiographic grid played a major role. A radio-opaque metal mesh or a grid is placed between the object/structures to be imaged and the radiographic film/sensor at the time of x-ray exposure. The two adjacent parallel lines of the grid used should be equidistant. They are made up of thick and thin wire of copper, when superimposed along with the film and exposed the film shows anatomic landmarks with grid lines which are 1 mm apart running both lengthwise, width wise and every fifth millimeter is accentuated by a heavier line to make easier the reading of finished radiograph.[41]

In the present study of the evaluation of crestal bone levels mesially and distally. Overall, a statistically significant difference in mean crestal bone height at mesial side was found among different follow ups.

Post hoc pairwise comparison of mean crestal bone height on mesial side was done using Wilcoxon test as depicted in TABLE 3. It was found that mean crestal bone loss at 0 month & 3 month were found to be significantly lower about <0.001 than that at 6 month, the value for which was 0.002 that was further significantly lower than that at 24 months(0.046), which was further significantly lower than that at 36 months(0.046), which was further significantly lower than that at 48 months(0.001), which was further significantly lower than that at 60 months which came around 0.003.

Similarly, a statistically significant difference in mean crestal bone height at distal side was found among different follow ups.

Bone loss occurred predominantly during the healing and remodelling, periods, i.e. from fixture installation to the end of the first year after bridge connection. However over a period of time the bone loss was decreased in comparison to the first year with

almost being the same for a 12-18 month duration. The mean values for the mesial side at borderline, 3 months, 6 months, 24months, 36 months, 48 months and 60 months were .000, .000, .0000, .0507, .0488, .0488, .0704. The p value for the mesial side was found to be <0.001.

The mean values for the distal side at borderline, 3 months, 6 months, 24months, 36 months, 48 months and 60 months were .000, .0507, .0352, .0507, .0507, .0352, .0535. The p value for the distal side was found to be <0.001.

Table 5 describes the Post hoc pairwise comparison of mean crestal bone height on distal side done using Wilcoxon test. It was found that mean crestal bone height at 0 month <0.001 was found to be significantly lower than that 3 month (<0.001). It was significantly lower than that at 6 month found to be 0.008 which was further significantly lower than that at 24 months(0.008) & 36 months (0.008), which were further significantly lower than that at 48 months (<0.001), which was further significantly lower than that at 60 months(<0.001). No statistically significant difference could be found in the mean crestal bone height at 24 months & 36 months.

The overall crestal bone loss was found to be statistically significant difference among different follow ups. The P value was found to be 0.0001. It was found that mean crestal bone height at 0 month <0.001 was found to be significantly lower than that 3 month (<0.001). It was significantly lower than that at 6 month found to be 0.002 which was further significantly lower than that at 24 months(0.046) & 36 months (0.002), which were further significantly lower than that at 48 months (<0.003), which was further significantly lower than that at 60 months(0.001).

Interestingly, in these studies and in ours, the mean ABL rate was lower than the proposed threshold acceptable for long-term implant success: 0.2mm (Albrektsson et al. 1986).

As reported by Cochran et al in a clinical study, the most significant amount of bone loss occur between the time of placement and the time that the definitive prosthesis was placed. One factor that may induce bone loss is the interruption of the vascular supply to bony structures during preparation of the implant site.

A survey questionnaire was distributed to patients for completion which was made to determine the satisfaction and quality of life of the patient after implant placement. After informed consent was obtained, each patient was asked to fill out a satisfaction questionnaire regarding aspects of cost, comfort, crown shape and color (esthetics), ability to eat, gum shape and color (gingival health), food impaction, phonetics, prosthesis loosening, and general satisfaction.

Responses to statements were given on the Likert response scale, e.g. 5 = strongly agree; 4 = agree; 3 = neither agree nor disagree; 2 = disagree; 1 = strongly disagree for each of these parameters. Although patients responded to most of the statements with high satisfaction, most of the patients had low percent of response for the cost treatment. Pjetursson *et al*.[42] reported in his study that the costs associated with implant therapy in Switzerland were considered to be justified, while Tepper *et al*. described the implant supported rehabilitation to be very expensive in Austria.[43]

They were highly satisfied with chewing capacity and esthetics of the prosthesis.

Thus it appears that the marginal bone loss was significantly decreased with consecutive time period but overall the loss of bone was significant. This was found

in accordance with the study conducted by Adell in 1981. The marginal bone loss could be attributed to several factors:

1. Effects of surgical trauma such as detachment of the marginal periosteum, removal of marginal bone and bone damage at drilling.

2. Inadvertent stress distribution to the marginal bone by forced tightening of the fixtures at installation" or by later inadequate loading. This could be related to a number of factors.

a. Trauma from occlusion and/or from unfavourable relations between the jaws, even with a properly designed bridge.

b. Defective bridge design concerning adaptation to abutments, occlusal adjustment, extension, etc.

3. Physiological resorption of the edentulous jaw.

4. Gingivitis which, if untreated and allowed t o progress down to the periosteum, may in the long run cause bone resorption.

Interfaces that are created between the implant components as part of the implant restoration is another factor that can influence bone remodeling, resulting in a loss of bone around the implant. If these involve butt–joint interfaces, significant amounts of inflammation develop around the interface, likely in response to bacterial contamination. [44]

Bacterial products stimulate inflammatory cells to enter the surrounding tissues, and these cells release pro inflammatory molecules that recruit more inflammatory cells; osteoclastogenesis and, eventually, bone loss result.[45]

Data indicate that the closer this inflammation is located to the alveolar crest, the more bone loss is observed.[46]

The clinical success and integrity of endoosteal dental implants are controlled majorly by the health of the surrounding crestal bone region and the soft tissues. Implants with crestal bone loss displayed increasing attachment levels and increasing recession depth over time, while implants with crestal bone gain showed the opposite.[47]

Conclusion

The present in-vivo study assessed the crestal bone levels radio-graphically for a period of up-to 5 years. Evaluations were carried out at baseline i.e. the day of implant placement, 60th day and 90th day, 24, 36, 48 and 60 months. Following conclusions were drawn:

1. It was found that mean crestal bone height at 0 month & 3 month were found to be significantly lower than that at 6 month.
2. It was further significantly lower than that at 24 months, which was further significantly lower than that at 36 months, which was further significantly lower than that at 48 months, which was further significantly lower than that at 60 months.

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Annexures

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES (FACULTY OF BBD UNIVERSITY), LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Evaluation of Crestal Bone Levels after Placement and A Follow-Up Upto 5 Years- A Radiographic Perspective"** submitted by **Dr Arushi Agarwal** Post graduate student from the **Department of Prosthodontics & Crown and Bridge** as part of MDS Curriculum for the academic year 2019-2022 with the accompanying proforma was reviewed by the Institutional Research Committee present on **19th December 2019** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the VIII[th] Institutional Ethics Sub-Committee

IEC Code: 16 **BBDCODS/03/2020**

Title of the Project: Evaluation of Crestal Bone Levels after Placement of Dental Implants and A Follow-Up Upto 5 Years- A Radiographic Perspective.

Principal Investigator: Dr. Arushi Agarwal **Department:** Prosthodontics & Crown and Bridge

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr. Arushi Agarwal,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 18[th] March, 2020.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow
2.	Dr. Amrit Tandan Member	Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow
3.	Dr. Sahana S. Member	Reader, Department of Public Health Dentistry, BBDCODS, Lucknow
4.	Dr. Sumalatha M.N. Member	Reader, Department of Oral Medicine & Radiology, BBDCODS, Lucknow

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.

The comments were communicated to PI thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala 18/03/20

(Dr. Lakshmi Bala)
Member-Secretary
IEC

Member-Secretary
Institutional Ethic Committee
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(Dr. B. Rajkumar)
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(Babu Banarasi Das University)
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Consent Form (English)

Title of the Study ……..

Study Number……..

Subject's Full Name…….

Date of Birth/Age ……

Address of the Subject…….

Phone no. and e-mail address……

Qualification ……

Occupation: Student / Self Employed / Service /
Housewife/ Other (Please tick as appropriate)

Annual income of the Subject……

Name and of the nominees(s) and his relation to the subject.....(For the purpose of
compensation in case of trial related death).

1. I confirm that I have read and understood the Participant Information Document dated ……..for the above study and have had the opportunity to ask questions. **OR** I have been explained the nature of the study by the Investigator and had the opportunity to ask questions.
2. I understand that my participation in the study is voluntary and given with free will without any duress and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.
3. I understand that the sponsor of the project, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.
4. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).
5. I permit the use of stored sample (tooth/tissue/blood) for future research. **Yes [ ] No [ ]**
6. I agree to participate in the above study. I have been explained about the complications and side effects, if any, and have fully understood them. I have also read and understood the participant/volunteer's Information document given to me.

Signature (or Thumb impression) of the Subject/Legally
Acceptable Representative:……..

Signatory's Name……. Date …….
Signature of the Investigator…… Date……..
Study Investigator's Name..... Date……..
Signature of the witness…… Date……..
Name of the witness……

Received a signed copy of the PID and duly filled consent form
Signature/thumb impression of the subject or legally
Acceptable Representative Date…
…..

Participant Information Document (PID)

Study title : Evaluation Of Crestal Bone Loss After Placement Of Dental Implants and a Follow-up Upto 5 Years – A Radiographic Perspective.

You are being invited to take part in a research study, it is therefore important for you to understand why the study is being done and what it will involve. Please take time to read the following information carefully. Ask us for any clarifications or further information. Whether or not you wish to take part is your decision. The purpose of this study is to assess the prognosis of dental implants. Crestal bone levels will be evaluated for a period of up-to five years. You have been chosen for this study as you are fulfilling the required criteria for this study. Your participation in the research is entirely voluntary. If you do, you will be given this information sheet to keep and will be asked to sign a consent form. During the study you still are free to withdraw at anytime and without giving a reason. There may be less crestal bone loss and better peri-implant soft tissue health than usually seen in such cases. You need to follow the same precautionary methods as advised for usual implant patients. After the placement of the prosthesis on the implant, you will be required to come for follow up every 6 to 12 months for 5 years.

In this study, participants radiographs with grid of dental implants will be taken at different time intervals of 24, 36,48 and 60 months. The mesial and distal bone levels will be recorded and comparison will be made in co-relation with Vitamin D3 levels.

There are no side effects on patients of this study.

If additional information becomes available during the course of the research you will be told about these and you are free to discuss it with your researcher, your researcher will tell you whether you want to continue in the study. If you decide to withdraw, your researcher will make arrangements for your withdrawal. If you decide to continue in the study, you may be asked to sign an updated consent form.

This research study is organized by the academic institution. You do not have to pay for any additional procedures involved apart from the usual cost of treatment.

Signature of PI……

Name……

Date ……....

MASTER CHART

1. MESIAL SIDE

TOOTH NO.	AT BASELINE	3 MONTHS	6 MONTHS	24 MONTHS	36 MONTHS	48 MONTHS	60 MONTHS
24	0	0	0.1	0.1	0.2	0.2	0.3
36	0	0	0.1	0.1	0.2	0.2	0.2
37	0	0	0.1	0.2	0.2	0.3	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
36	0	0	0.1	0.1	0.1	0.2	0.2
46	0	0	0.1	0.1	0.1	0.2	0.2
36	0	0	0.1	0.2	0.2	0.3	0.4
46	0	0	0.1	0.1	0.1	0.2	0.3
45	0	0	0.1	0.2	0.2	0.2	0.3
24	0	0	0.1	0.1	0.2	0.2	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
36	0	0	0.1	0.2	0.2	0.3	0.4
37	0	0	0.1	0.2	0.2	0.3	0.3
24	0	0	0.1	0.1	0.2	0.2	0.3
36	0	0	0.1	0.1	0.2	0.2	0.2
24	0	0	0.1	0.2	0.2	0.3	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
24	0	0	0.1	0.1	0.1	0.2	0.3
37	0	0	0.1	0.1	0.1	0.2	0.2
25	0	0	0.1	0.1	0.1	0.2	0.2
37	0	0	0.1	0.2	0.2	0.3	0.4
25	0	0	0.1	0.1	0.1	0.2	0.3
24	0	0	0.1	0.2	0.2	0.2	0.3
37	0	0	0.1	0.1	0.2	0.2	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
37	0	0	0.1	0.2	0.2	0.3	0.4
24	0	0	0.1	0.2	0.2	0.3	0.3
25	0	0	0.1	0.1	0.2	0.2	0.3
45	0	0	0.1	0.1	0.2	0.2	0.2
26	0	0	0.1	0.2	0.2	0.3	0.3
45	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
24	0	0	0.1	0.1	0.1	0.2	0.2
26	0	0	0.1	0.1	0.1	0.2	0.2
45	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
24	0	0	0.1	0.2	0.2	0.2	0.3
45	0	0	0.1	0.1	0.2	0.2	0.3
37	0	0	0.1	0.2	0.2	0.3	0.4
24	0	0	0.1	0.1	0.1	0.2	0.3
45	0	0	0.1	0.2	0.2	0.3	0.4

37	0	0	0.1	0.2	0.2	0.3	0.3
24	0	0	0.1	0.2	0.2	0.3	0.4
45	0	0	0.1	0.1	0.1	0.2	0.3
37	0	0	0.1	0.2	0.2	0.3	0.4
37	0	0	0.1	0.2	0.2	0.3	0.3

2. DISTAL SIDE

TOOTH NO.	AT BASELINE	3 MONTHS	6 MONTHS	24 MONTHS	36 MONTHS	48 MONTHS	60 MONTHS
24	0	0.1	0.1	0.2	0.2	0.2	0.3
36	0	0.1	0.1	0.2	0.2	0.2	0.3
37	0	0	0.1	0.1	0.1	0.2	0.2
25	0	0	0.1	0.1	0.1	0.2	0.3
26	0	0	0.1	0.2	0.2	0.2	0.3
36	0	0	0.1	0.1	0.1	0.2	0.3
46	0	0.1	0.2	0.2	0.2	0.3	0.4
36	0	0.1	0.2	0.2	0.2	0.3	0.4
46	0	0	0.1	0.1	0.1	0.2	0.3
45	0	0	0.1	0.2	0.2	0.2	0.3
24	0	0	0.1	0.1	0.2	0.2	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
36	0	0	0.1	0.2	0.2	0.3	0.4
36	0	0	0.1	0.1	0.2	0.2	0.2
24	0	0	0.1	0.2	0.2	0.3	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
24	0	0	0.1	0.1	0.1	0.2	0.3
37	0	0	0.1	0.1	0.1	0.2	0.2
25	0	0	0.1	0.1	0.1	0.2	0.2
37	0	0	0.1	0.2	0.2	0.3	0.4
25	0	0	0.1	0.1	0.1	0.2	0.3
24	0	0	0.1	0.2	0.2	0.2	0.3
37	0	0	0.1	0.1	0.2	0.2	0.3
25	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
37	0	0	0.1	0.2	0.2	0.3	0.4

24	0	0	0.1	0.2	0.2	0.3	0.3
25	0	0	0.1	0.1	0.2	0.2	0.3
45	0	0	0.1	0.1	0.2	0.2	0.2
26	0	0	0.1	0.2	0.2	0.3	0.3
45	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
24	0	0	0.1	0.1	0.1	0.2	0.2
26	0	0	0.1	0.1	0.1	0.2	0.2
45	0	0	0.1	0.2	0.2	0.3	0.4
26	0	0	0.1	0.1	0.1	0.2	0.3
24	0	0	0.1	0.2	0.2	0.2	0.3
45	0	0	0.1	0.1	0.2	0.2	0.3
37	0	0	0.1	0.2	0.2	0.3	0.4
24	0	0	0.1	0.1	0.1	0.2	0.3
45	0	0	0.1	0.2	0.2	0.3	0.4
37	0	0	0.1	0.2	0.2	0.3	0.3
24	0	0	0.1	0.2	0.2	0.3	0.4
45	0	0	0.1	0.1	0.1	0.2	0.3
37	0	0	0.1	0.2	0.2	0.3	0.4
37	0	0	0.1	0.2	0.2	0.3	0.3

QUESTIONNAIRE

Categorized statements	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1. The cost of the treatment was reasonable.					
2. I feel comfortable when I chew on my implant prosthesis.					
3. I am pleased with the esthetic results.					
4. I can chew on my crown or bridge very well.					
5. The tissue around the implant bleeds less than around the teeth.					
6. I haven't felt uncomfortable because of food packing during chewing.					
7. I can speak well with my crown or bridge.					
8. I haven't been to the clinic because the prosthesis had come loose and I feel secure that my implant prosthesis will stay in place while eating and speaking.					
9. I am satisfied with my implant prosthesis.					

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