# BABU BANARASI DAS UNIVERSITY

## BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW

# ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC STUDY

**DISSERTATION**

**Submitted to**

**BABU BANARASI DAS UNIVERSITY,**

**LUCKNOW, UTTAR PRADESH**

***In the partial fulfilment of the requirements for the degree***

***of***

**MASTER OF DENTAL SURGERY**

**in**

**PERIODONTOLOGY**

**By**

**Dr JIGME PALZOR DENZONGPA**

**Under the guidance of**

**Dr VANDANA A. PANT**
**PROFESSOR**

**Dr SUNIL C.VERMA**
**READER**

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**Enrolment no: 1200328002**

# DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC STUDY** " is a bonafide and genuine research work carried out by me under the guidance of **Dr VANDANA A. PANT,** Professor, Department of Periodontology, and Co-Guide **Dr SUNIL C. VERMA** ,Reader, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Date: 11/02/2023

Place: Lucknow

Jigme

**Dr JIGME PALZOR DENZONGPA**

# CERTIFICATE BY THE GUIDE/CO-GUIDE

This is to certify that the dissertation entitled **"ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC STUDY"** is a bonafide work done by **Dr Jigme Palzor Denzongpa,** under our direct supervision and guidance in partial fulfilment of the requirement for the degree of MDS in Periodontology.

Date:

**GUIDE**

11/02/2023

**Dr VANDANA A PANT**
Professor,
Department of Periodontology
B B D C O D S
BBD University, Lucknow (U.P.)

**CO- GUIDE**

**Dr SUNIL C. VERMA**
Reader,
Department of Periodontology
B B D C O D S
BBD University, Lucknow (UP)

# ENDORSEMENT BY THE HOD

This is to certify that the dissertation entitled "**ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC STUDY**", is a bonafide work done by **Dr Jigme Palzor Denzongpa**, under direct supervision and guidance of **Dr VANDANA A. PANT**, Professor, Department of Periodontology, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Mona 11/02/23

**Dr MONA SHARMA**

Professor and Head

Department of Periodontology

B B D C O D S

BBD University, Lucknow (U.P.)

# ENDORSEMENT BY THE HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC STUDY "**, is a bonafide work done by **Dr Jigme Palzor Denzongpa**, under the direct supervision and guidance of **Dr VANDANA A PANT**, Professor, Department of Periodontology, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

**Dr PUNEET AHUJA**

Principal

B B D C O D S

BBD University, Lucknow (U.P.)

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Date: 11/02/2023

Place: Lucknow

Jigme

**Dr Jigme Palzor Denzongpa**

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***Dr Jigme Palzor Denzongpa***

***Enrollment no - 1200328002***

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# *LIST OF ABBREVIATIONS*

| | |
|---|---|
| **SLA** | Sandblasted and acid etching |
| **mPI** | Modified Plaque index |
| **mBI** | Modified Sulcus Bleeding index |
| **BOP** | Bleeding on probing |
| **RCTs** | Randomized controlled trials |
| **RFA** | Resonance frequency analysis |
| **ISQ** | Implant Stability quotient |
| **DAE** | Dual acid-etched |
| **CSR** | Cumulative survival rate |
| **CAD/CAM** | Computer aided design / Computer aided manufacturing |
| **CIR** | Crown-to-implant ratio |
| **SDI** | Short dental implants |
| **MBL** | Marginal Bone Loss |
| **BIC** | Bone-implant contact |
| **PPD** | Probing pocket depth |
| **RVG** | Radiovisiography |
| **XCP** | Extension cone paralleling |
| **PFM** | Porcelain fused to metal |
| **IAN** | Inferior alveolar nerve |
| **CBCT** | Cone-beam computed tomography |
| **IOPARs** | Intraoral periapical radiographs |
| **OPGs** | Orthopantomograms |

There are various reasons for a tooth loss, some of them are periodontitis, dental caries, injury, developmental flaws, and genetic abnormalities. Out of these, Periodontitis is the most common cause. Placement of conventional implant is a challenging task in cases with advanced bone loss in the alveolar bone. One method to get around this restriction would be to use implants with short or non-standard diameters. In the posterior maxilla, short implants might be used in place of conventional implants alongside supplementary surgeries. Short implants can be a better alternative to longer implants if it can be ascertained that it is equally good if not better than longer conventional implants. Apart from being more affordable and quicker option than the conventional one, it can also help avoid supplementary surgery which are undertaken to enhance available bone. Patients were chosen on the basis of inclusion and exclusion criteria. In this study, direct comparisons were made where only the placement of ultra-short implants was performed. The results obtained from this study were eventually compared with the data obtained from a well-known systematic review by Lemos et al. (2016). In the posterior edentulous sites with alveolar ridges wider than or equivalent to 8 mm, a total of 10 ultra short implants were inserted. A 6 months worth of time was used to evaluate the marginal bone loss (MBL). modified Plaque Index (mPI), modified Sulcus Bleeding Index (mGI), and Probing Pocket depth (PPD) were recorded in various time intervals for up to six months. The results obtained from this study demonstrated that single unit restorations in the upper jaws can be supported by ultra-short dental implants. Regarding implant survival rates, marginal bone loss, co-morbidities, there was no discernible difference between standard and ultra-short implants. It can be thus inferred that implantation of ultra-short implants can therefore be a cost-effective treatment option with outcomes comparable to those of traditional implants.

# INTRODUCTION

For the past few decades, implants have been regarded as the ideal treatment for rehabilitating jaws that have lost all or part of their teeth. Standard-length implants cannot be used in many clinical scenarios because they would interfere with important anatomical structures including the alveolar nerve and the maxillary sinus[1]. Loss of teeth in the posterior jaws facilitates the resorption process of bone tissue resulting in closer proximity of the inferior alveolar nerve and maxillary sinus to the alveolar crest bone. Conventional implants cannot be placed in such cases. Bone augmentation surgery which involves bone grafts, sinus floor elevation, guided bone regeneration, distraction osteogenesis and mandibular nerve transportation have been used to restore the height of the bone tissue to enable the insertion of conventional implants. According to reports, these procedures have typically high success rates in implantology, but the results have been inconsistent and unpredictable[2]. These surgeries are also expensive and requires numerous surgical procedures. Patients,especially those who are of poor general conditions, are also unable or reluctant to undergo this type of surgical approach[3]. The risk of paresthesia is further increased by inferior alveolar nerve transposition procedures[4]. Short implants are simple and effective in restoring such atrophic ridges[5]. It has the advantage of requiring fewer surgeries and causing less trauma during those surgeries. Less morbidity and postoperative discomfort benefit the patients[6]. Short implants have recently gained popularity as the idea of "stress-minimizing surgery" has gained more attention. This is due to the fact that they offer a number of benefits, such as fewer clinical skills requirements, quicker surgical times, lower treatment costs, and improved patient-reported outcomes[1].

Shorter implants were previously widely reported to have higher failure rates, because of which researchers concentrated on inserting the longest implant possible in order to enhance the likelihood of implant survival. More recent research, along with the slow spread of the best-performing rough surfaces to replace the machined ones on the market, shows success rates comparable to those of longer implants[4,7]. In relation to this, it's critical to emphasise the distinction between "success" and "survival," where "success" refers to whether a given implant satisfies the success criteria it is being evaluated with and "survival" merely refers to the implant's presence in the mouth.

Misch et al.[4] conducted a literature analysis in 2006 and looked into the failure rates of posterior jaw dental implants less than 10 mm long placed between 1991 and 2003. In a sample of 2837 short implants, 85.3% of the implants were effective; the majority of the failures were after prosthetic loading, and other authors have also demonstrated that implant length had no effect on the failure rate[8,9]. The maximum crown to implant ratio shouldn't be greater than 1:1 to prevent overloading, according to some writers concerned about the length of implants who conducted empirical research years ago[10,11,12]. Since then, it has been proven that even a crown-to-implant ratio of more than 2:1 has no deleterious effects on the prosthetic rehabilitation's short- or long-term success[13,14].

There is disagreement among authors as to what constitutes a short implant; some define it as being less than 10 mm[15,16], while others define it as being less than 8 mm[17]. Implants that are 7 mm in length or less are regarded as short or extra-short implants according to current clinical trends[18] whereas other define it to be the ones with an intrabony length of no more than 5 mm[19]. Disparity in the crown-to-implant ratio increases the risk of mechanical problems however it does not lead to peri-implant marginal bone loss.[20]

The area where the implants will be placed is another crucial factor to think about because low-density bone, like that seen in the posterior maxilla, increases the likelihood of failure[21]. There is lack of general consensus on the survival rate of short implants in the posterior maxilla and mandible[22]. While some writers have found low success rates for short implants,[23,24] others have shown great success rates.[25-27] . In this study, implants of length 5.5mm were taken and named as “ultra short” implants. This study was conducted to assess and establish the success of ultra short implants in maxillary arch because there is a dearth of literature demonstrating their success and failures.

# AIM AND OBJECTIVES

**AIM:**

To assess the success of "Ultra" short implants (5.0×5.5mm) in maxillary arch at different time interval.

**OBJECTIVES:**

i. To measure the Marginal Bone Loss (MBL) at base line, 3 months and at 6 months post loading.

ii. To measure the Implant mobility after 6 months.

iii. To measure the modified Plaque Index (mPI), modified Sulcus Bleeding Index (mBI) and Probing Pocket Depth (PPD) at 3 months and at 6 months post loading.

iv. To compare the final results with pre-existing data of conventional implants.

# REVIEW OF LITERATURE

**C M ten Bruggenkate et al, 1998**[28] conducted a multicenter study of short ITI implants. In a 6-year period 253 short implants with a length of 6 mm were placed into 126 patients, who were followed up from 1 to 7 years. The quality of survival was comparable with the clinical results of longer implants from the same implant system. Although the clinical results of these short implants were favorable, they concluded that they be used in combination with longer implants, especially when used in the less dense bone that is often seen in the maxilla.

**Akca K et al, 2002**[29] conducted a study to evaluate the effect of additional placement of a shorter implant in place of a cantilever extension on stress distribution compared with cantilevered fixed prosthesis in mandibular posterior edentulism. An oblique occlusal load of 400 N was applied. Significant lower stress values were recorded at the shorter implant placement configurations compared with the cantilevered prosthesis. They concluded that in clinical applications where cantilevered fixed partial prosthesis seems to be inevitable because of anatomical restrictions and/or complications such as loss of implant, an additional placement of a shorter implant should be considered.

**Hagi D et al, 2004**[30] conducted a study to assess the relationship between dental implant failure rates and their surface geometry, length, and location (maxilla versus mandible). Twelve papers were identified as follows: eight with machined threaded implants, two with acid-treated threaded implants, and two with sintered porous-surfaced press-fit implants. They concluded that Dental implant surface geometry was a major determinant in how well these implants perform in short lengths, defined here as lengths of < or =7 mm. According to them, threaded implants show higher failure rates in short versus longer lengths, sintered porous-surfaced implants perform well in the defined "short" lengths.

**Feldman S et al, 2004**[31] conducted an analysis of prospective multicenter clinical studies evaluating the risk for failure of short-length implants, comparing dual acid-etched (DAE) Osseotite implants to machined-surfaced implants. The implant data included 2294 implants for the DAE series and 2597 implants for the machined-surfaced series. Cumulative survival rates (CSRs) were calculated with the

Kaplan- Meier estimator. In this analysis the difference in CSRs between short- and standard- length implants was greater for machined-surfaced implants than for DAE implants.

**Misch CE et al, 2005**[32] analysed a review which reveals implants shorter than 10 mm often have a higher failure rate than longer implants. These complications may be related to an increase in crown height, higher bite forces in the posterior regions, and less bone density. The authors concluded that the forces to the implants may be reduced by eliminating lateral contacts in mandibular excursions and eliminating cantilevers on the prosthesis. The area of forces applied to the prosthesis may be increased by increasing the implant number, increasing the implant diameter, increasing the implant design surface area, and splinting the implants together. As a result of these biomechanical methods to decrease stress, Misch, et al reported a 99% implant survival with 7-mm and 9-mm implants in the posterior regions of the jaws.

**Renouard F et al, 2006**[33] conducted a retrospective study to assess the survival rates of 6 to 8.5 mm-long implants in the severely resorbed maxilla following a surgical protocol for optimized initial implant stability. The study included 85 patients with 96 short (6–8.5 mm) implants supporting single-tooth and partial reconstructions. The cumulative survival rate was 94.6%. The authors concluded that the use of short implants maybe considered for prosthetic rehabilitation of the severely resorbed maxilla as an alternative to more complicated surgical techniques.

**Morand M et al, 2007**[34] conducted a study in order to assess the challenge of implant therapy in the posterior maxilla. An extensive review of the literature that is available for short implants (implants < 10 mm in length) indicates that although they are commonly used in areas of the mouth under increased stress (posterior region), their success rates mimic those of longer implants when careful case selection criteria have been used. The authors concluded that the available studies and case-series offer a valid rationale for placement of short implants so long as one understands the limitations, indications, risk factors, and limited studies that actually follow-up success rates of short implants for over 5 years.

**Anitua E et al, 2008**[35] conducted a study to evaluate the long-term survival rates of short dental implants in posterior areas and to analyze the influence of different factors on implant. Two of 532 implants were lost during the observation period. The overall survival rates of short implants were 99.2% and 98.7% for the implant- and subject-based analyses, respectively. The authors concluded that treatment with short implants can be considered safe and predictable if used under strict clinical protocols.

**Romeo E et al, 2010**[36] conducted a study to evaluate the differences in survival rate and the rational use of short implants. Some of the parameters the clinician should consider are: 1) area to rehabilitate as well as bone quality; 2) length of the implant; 3) implant diameter; 4) type of implant and surface treatment; 5) crown to implant ratio of the final prostheses; 6) type of prostheses; 7) connection to other implants; 8) occlusal/ parafunctional load; 9) prosthetic complications. The authors concluded that it can be assumed that a careful treatment planning can lead the clinician to obtaina successful rehabilitation.

**Sun HL et al, 2011**[37] conducted a study to evaluate the long-term failure rates of short dental implants (</ 10 mm) and to analyze the influence of various factors on implant failure. The total failure rate was 4.5%. There was a tendency toward higher failure rates for the maxilla and for dental implants with a machined surface comparedwith the mandible and dental implants with a rough surface, respectively. The authors concluded that most failures of short implants can be attributed to poor bone quality inthe maxilla and a machined surface.

**Karthikeyan I et al, 2012**[38] conducted a study to systematically evaluate the publications concerning short dental implants (< 7 mm) placed in the maxilla or in the mandible between 1991 and 2011. The survival rate of short implants was found to be increased from 80% to 90% gradually, with recent articles showing 100%. They concluded that short implants could be a preferable choice as the treatment becomes faster and cheaper and these are associated with less morbidity than vertical bone augmentation.

**Lai HC et al 2013**[39] conducted a study to evaluate the long-term clinical and radiographic outcomes of short implants supporting single crowns in the posterior regions. High survival rates for both the implants and the prostheses could be achieved after 5-10 years for short implants supporting single crowns, without severe marginal bone loss and complications. The authors concluded that a single crown supported by a short implant is a predictable treatment modality. However, short implants in type IV bone sites should be applied with caution.

**Monje A et al, 2013**[40] conducted a study to compare the survival rate of short (<10mm) and standard (≥10mm) rough surface dental implants under functional loading. The peak failure rate of short dental implants was found to occur between 4 and 6 years of function whereas the peak failure rate of standard implants was between 6 and 8 years of function. They concluded that in the long term implants of <10 mm are as predictable as longer implants but they fail at an earlier stage compared to standard implants.

**Shetty S et al 2014**[41] conducted a study to assess the effectiveness of short implants in rehabilitation of atrophic maxilla and mandible. Short implants are considered as a viable alternative in patients with reduced alveolar bone height to avoid more invasiveprocedures. They concluded that various methods to increase the functional surface area and decrease the stress on the prosthesis have greatly contributed to the success rate of short implants.

**Srinivasan M et al, 2014**[42] conducted a review to test the hypothesis that 6mm micro rough short Straumann implants provide predictable survival rates and also to verify that most failures occurring are early failures. Studies were included that involved Straumann 6mm implants placed in the human jaws, which provided data on the survival rate, which mentioned the time of failure and which reported a minimum follow up period of 12 months following placement. They concluded that micro rough6mm short dental implants are a predictable treatment option providing favorable survival rates.

**Thoma DS et al 2015**[43] conducted a study to compare short implants in the posterior

maxilla to longer implants placed after or simultaneously with sinus floor elevation procedures. Based on the pooled analyses of longer follow-ups (5 studies, 16-18 months), the survival rate of longer implants amounted to 99.5% and for shorter implants to 99.0% The authors concluded that given the higher number of biological complications, increased morbidity, costs and surgical time of longer dental implants in the augmented sinus, shorter dental implants may represent the preferred treatment alternative.

**Lemos CAA et al, 2016**[44] conducted a study to compare short implants (equal or less than 8 mm) versus standard implants (larger than 8mm) placed in posterior regions of maxilla and mandible, evaluating survival rates of implants, marginal bone loss, complications and prosthesis failures. The results showed that there was no significant difference of implants survival, marginal bone loss, complications and prosthesis failures. Short implants are considered a predictable treatment for posterior jaws.

**Pohl V et al, 2017**[45] conducted a 3 year multi centre study to test whether the use of short dental implants (6 mm) results in an implant survival rate similar to that with longer implants(11-15 mm) in combination with sinus grafting. The assessed outcomes included were implant survival, marginal bone level changes, probing pocket depth, bleeding on probing and plaque accumulation. They concluded that short implants (6 mm) in the posterior maxilla as a viable solution versus long implants in combination with sinus lift.

**Lombardo G et al 2017**[46] conducted a study to determine cumulative success rate (CSR) of short and ultrashort implants in the posterior maxilla restored with single crowns. Success rate, clinical and radiographic outcomes, and crown-to-implant ratio (CIR) were assessed after three years. The authors suggested that short and ultrashort implants may be successfully placed and restored with single crowns in the resorbed maxillary molar region.

**Shah SN et al 2018**[47] Conducted a randomized trial to assess clinical and radiographic outcomes of short versus standard dental implants placed with

concomitant vertical bone augmentation. Patients requiring dental implants were randomized to receive either 6-mm implants (experimental) or 10-mm implants with vertical augmentation (control). Custom load-bearing healing abutments were connected to allow for indirect resonance frequency analysis measurements. Standardized radiographs were taken at implant placement (baseline), and at 3 and 12 months. Implants were restored at 3 to 6 months, and final measurements were taken at 12 months. The authors concluded that short dental implants may offer an alternative for implant placement in an atrophic jaw; however, they were associated with reduced first-year survival rate.

**Papaspyridakos P et al 2018**[48] conducted a study to review long-term survival and failure rates, as well as the complications of short implants (≤6 mm) versus longer implants (>6 mm) in posterior jaw areas. The short implant survival rate ranged from 86.7% to 100%, whereas standard implant survival rate ranged from 95% to 100% with a follow-up from 1 to 5 years. The authors concluded that short implants with ≤6 mm length should be carefully selected because they may present a greater risk for failure compared to implants longer than 6 mm.

**Pommer B et al 2018**[49] Conducted a study to review available evidence in scientific literature on oral implants of severely reduced length or diameter. A total of 2929 extra-short implants and 3048 extra-narrow diameter implants were investigated in 53 and 29 clinical studies, respectively. Shorter implants between 4.0 mm and 5.4 mm in length showed comparable results to implant lengths of 5.5 mm to 6.5 mm (95.1% vs. 96.4%,) and no difference regarding marginal bone resorption (0.7 mm vs 0.5 mm). Implant lengths of 5.5 mm to 6.5 mm, however, performed significantly better in the mandible compared with the maxilla. Smaller diameters between 3.0 mm and 3.25 mm yielded a significantly lower survival rate of 94.3% than wider implants of 3.3 mm to 3.4 mm diameter (97.7%), while marginal bone resorption did not differ (0.4 mm vs 0.5 mm). Based on these data the authors concluded that extra-short and extra-narrow-diameter implants show satisfactory survival rates of around 95% and little marginal bone resorption of around 0.5 mm after a mean follow-up of 3 years. However, implant lengths < 7 mm in the maxilla and < 5.5 mm in the mandible as well as diameters < 3.3 mm may increase early failure rates.

**Fabris V et al 2018**[50] conducted a study to access an association of guided bone regeneration (GBR) with the use of extra-short implants which might be a viable alternative for regions with limited bone height. The authors concluded that the association of GBR with the use of extra-short implants was a viable alternative after a 3-year follow-up.

**Ravidà A et al 2019**[51] conducted a study to compare the clinical outcomes of ≤6 mm extra-short implants (testgroup) versus ≥10 mm long implants (control group), with and without bone augmentation procedures. Eighteen studies comprising 1,612 implants (793 extra-short and 820 long implants) were selected for the meta-analysis. No statistically significant difference in the survival rate was observed at 1 and 3 years. Extra-short implants displayed less marginal bone loss (MBL) from both implant placement time points (1 and 3 years) and prosthetic placement (1 year), as well as less biological complications, surgical time and treatment cost. Contrarily, a statistically significant small number of prosthetic complications were reported with long implants. The authors concluded that placement of extra-short implants (≤6 mm) presented as an equivalent option in the treatment of patients with an atrophic posterior arch up to 3-year follow-up.

**Malchiodi L et al, 2019**[52] conducted a study to determine how implant success rate is affected in the long term when ultra-short implants are rehabilitated with fixed restorations, resulting in a crown to implant (C/I) ratio of more than 3:1. All implants were sintered porous-surfaced (SPS) with a length of 5 mm and a diameter of 5 mm
(5 × 5 mm) and were restored with a single crown or a fixed dental prosthesis (FDP). Data collected included implant positioning site, crestal bone levels (CBL), and clinical and anatomical C/I ratios, and pre-established success criteria were used to evaluate the success rate of the implants. Forty-one patients completed the follow-up and were eligible for this retrospective study on a total of 50 ultra-short SPS implants. The mean follow-up was 9.5 years (range 8.3 to 10.2 years). They concluded that ultra-short SPS implants can prove a reliable solution for prosthetic restoration in patients with severe alveolar bone atrophy. In selected patients with a

sufficient bone width, ultra-short implants with a resulting C/I ratio of more than 3:1 presented no contraindications.

**Nizam N et al 2020**[53] conducted a study to assess the radiographic and clinical outcomes of extra-short implants either alone or in conjunction with osteotome sinus floor elevation and to compare these with regular-sized implants in the posterior atrophic maxilla. Systemically healthy, nonsmoker individuals having at least one tooth gap in the posterior maxilla were included in the study. When the residual bone height was < 4 mm, an extra-short implant (4 to 6 mm) in conjunction with osteotome sinus floor elevation was placed; when the residual bone height was between 4 and 7 mm, an extra-short implant alone was placed; and when it was ≥ 8 mm, a regular implant (8 to 10 mm) was placed. The implants were uncovered at 4 months, and porcelain-fused-to-metal crowns were fabricated. Crestal bone level, change in the crestal bone level, crown-to-implant ratio, and residual bone height were measured at baseline and 6 and 18 months postloading. Crestal bone level was significantly higher in the regular implant group compared with the extra-short implant with osteotome sinus floor elevation group at 18 months. Crestal bone level change between 6 and 18 months was significantly lower in the extra-short implant + osteotome sinus floor elevation group compared with the regular implant group. The authors concluded that Extra-short implants placed either in native bone or in conjunction with osteotome sinus floor elevation may provide similar clinical and radiographic outcomes that are comparable to those obtained with regular implants. Implant dimension, crown length, crown-to-implant ratio, and residual bone height may not affect the crestal bone level change, at least in the short term.

**Amato F et al 2020**[54] conducted a study to evaluate the cumulative survival rate and marginal bone loss (MBL) of extra-short (5- and 6-mm-long) and short (6.5-mm-long) implants inserted into severely atrophic, partially edentulous posterior maxillae and mandibles that were immediately restored with provisional fixed dental prostheses. Fifty-five patients were included in the study. A total of 62 extra-short (5 and 6 mm), 15 short (6.5 mm), and 69 standard-length (≥ 10 mm) implants were immediately placed and loaded. Cumulative survival rates were similar for all implants (99.3%). Implant length did not impart any significant differences in MBL, though the presence or absence of platform switching was influential. The authors

encouraged the use of short and extra-short implants to immediately restore with fixed prostheses in partially edentulous patients with severe vertical bone atrophy in posterior areas. It could be an alternative treatment to vertical bone augmentation.

**Capatti RS et al 2020**[55] conducted a study to evaluate, through the finite element method, the stress distribution generated at implant lengths of 4 mm and 10 mm caused by different crown heights (10, 12.5, and 15 mm) in the posterior maxilla region when submitted to axial (200 N) and oblique (100 N) loads. The 4-mm implant showed a similar level of performance as that of the 10-mm implant when submitted to the axial load. However, the oblique load proved to be highly detrimental to both implants, inducing stresses of up to three times higher than those achieved in conjunction with the axial load, especially in the surrounding bone and the abutment. The authors concluded that 4-mm short implants could be used to support single crowns in the posterior maxilla region in habitual conditions; however, the risk associated with significant oblique loads should be mitigated by adopting a mutually protected occlusion approach and using acrylic occlusal devices if necessary.

**Sumra N et al 2021**[56] conducted a study to evaluate the peri-implant Von Mises stresses, strains, and micromovements distribution in D4 bone quality around ultra-short implants of 5 mm length with varying diameters of 4 mm, 5 mm, and 6 mm. The finite element method was employed to make models replacing maxillary molars in D4 type bone that was missing. Implants of varying diameters (4, 5 and 6mm) that could be classified as ultrashort (5 mm) were used. In each model, the implant was subjected to a force of 100 N and analyzed. The force was applied in an oblique (45 degrees) and vertical direction (90°) to the long axis of the tooth. The models were made such that they simulated cortical and cancellous anisotropic properties of the bone. The models were then analyzed using the program ANSYS workbench version 12.1. Comparitively wide diameter, i.e., 6 mm threads had the least values of peri-implant von Mises stresses, strains, and micro-movements around them. Similarly square micro thread created the most favorable stress parameters around them with minimum values of stress, strains, and micromovements. The authors concluded that ultrashort implants combined with a wide diameter and platform switched can be used in atrophic ridges or when there is

a need for extensive surgery to prepare the implant site

**Fernandes GV et al 2022**[57] conducted study to compare the survival rate (SR), marginal bone loss (MBL) and clinical complications between extra-short implants (≤6 mm) and 6-mm-longer implants in randomized clinical trials. The data from 956 patients and 1779 implants were used with an overall mean clinical follow-up of 3.88 years ranging from 1 to 8 years. Overall, the SR of extra-short implants (93.12%) was lower than the observed in 6-mm-longer implants (95.98%); however, there was no statistical significance on these findings. MBL analysis showed that extra-short implants and the 6-mm-longer group presented an average of -0.71 and -0.92 mm after 1-year respectively. Three years follow-up showed MBL of -0.42 mm (≤6 mm) and -0.43 mm (>6 mm); 5 years follow-up showed an MBL of -0.69 mm (≤6 mm) and -0.46 mm (>6 mm); and after 8 years of follow-up, it was found an MBL of -1.58 mm (≤6 mm) and -2.46 mm (>6 mm). The authors observed that survival rate of extra-short implants was similar to 6-mm-longer implants. In contrast, marginal bone loss and the presence of clinical complications were observed at a lessened rate on extra-short implants.

# MATERIALS AND METHODS

***STUDY SETTING***

The study was carried out in the Department of Periodontology, Babu Banarasi Das College of Dental Sciences, Lucknow, Uttar Pradesh. The study commenced after receiving approval from the institutional ethical committee (IEC Code: 18, BBDCODS/04/2022).

***STUDY DESIGN***

It was a naïve direct comparison in which ultra- short implants were placed and the results obtained from it were compared to previous data from a well known systematic review by Lemos et al 2016.

1. *Experimental group:* Ultra-short implant of 5.0 × 5.5 mm was placed in posterior edentulous maxillary ridge.

2. *Control group:* Previously placed conventional implants in posterior edentulous maxillary ridge.

***STUDY POPULATION***

The subjects for the study were chosen from the patients who visited the Periodontology Department at Babu Banarasi Das College of Dental Sciences in Lucknow, Uttar Pradesh. In this longitudinal study, 20 patients with partly edentulous posterior ridges (12 men and 8 women; ages 25 to 65) were included.

***SUBJECT SELECTION***

**INCLUSION CRITERIA**

1. Age 25 – 65 years

2. Partial edentulism in posterior arch of maxilla with a residual bone height of 6.5-8mm.

3. Alveolar ridge width ≥ 8mm.

4. Presence of antagonist natural tooth or implant based prosthesis.

5. Completely healed post extraction socket.

6. Periodontally healthy patients.

7. Systemically healthy patients

8. Adequate patient compliance

9. Adequate inter occlusal space (7-8mm)

10. A good level of oral hygiene (full mouth plaque and gingival index scores <1).

**EXCLUSION CRITERIA**

1. Pregnant and Lactating females.

2. Requirement of bone augmentation during implant placement.

3. Alcoholic, drug abusers and smokers.

4. History of consumption of drugs affecting bone metabolism (bisphosphonate, antiresorptive medications, corticosteroids etc).

5. Patients taking any drugs (steroids, anticoagulants, anti-epileptics etc.) which are known to affect the healing and clotting mechanisms, causing gingival enlargement.

6. Known allergy/hypersensitivity to any product to be used in the study.

**Armamentarium for Diagnosis and Pre-clinical Assessment:**

- Mouth mirror
- UNC 15 periodontal probe (Hu- Friedy's™)
- Tweezers
- Metallic scale
- Hard tissue caliper (GDC Marketing , India)
- Digital OPG
- Diagnostic casts
- IOPA- Dental Xray grid (Navadha™)
- Plastic Probe
- Dental Xray Unit
- RVG- sensor and its positioner
- Vinyl Polysiloxane impression material (FLEXCEED™) and Elastomeric impression material (Neopure™)

**Armamentarium for surgery:**

- Local anesthesia ( Xylocaine 2% with Adrenaline)
- Syringe 3ml
- Normal Saline
- Bard Parker Handle
- Blade (no. 15). Blade (no. 12) was used wherever it was required
- Periosteal elevator
- Tissue holding forceps
- Castroviejo scissors
- Castroviejo needle holder
- Suture needle and suturing material (4-0 Ethicon)

- Suture cutting scissors
- Physiodispenser with Handpiece (W&H$^{TM}$)
- Implant kit (Dentium$^{TM}$ SHORT Implant)

***SAMPLE SIZE***

Sample size $n = \{Z^2 (1-\alpha)/2 . S^2\}/ d^2$

Where n = Required sample size

$Z (1-\alpha)/2$ = Standard normal variate ($\alpha = 0.05$)

S = Estimated standard deviation

d = Absolute error or Desired precision

Total Number of Patients: **10**

The patients were required to sign a written informed consent form and were told of the study's goal and design prior to its start. Each patient underwent a thorough clinical examination including initial radiographs and had a full medical and dental history collected.

***METHODOLOGY***

***INITIAL THERAPY***

Following an initial examination, diagnosis, and treatment plan, all 10 patients (8 men and 2 women) with partly edentulous posterior ridges underwent phase-I therapy, which included complete mouth scaling and root debridement utilizing hand and ultrasonic devices. Comprehensive oral hygiene instructions were given to all patients. Patients were recalled for follow-up examinations after every two weeks. During these follow-up, oral hygiene instructions were reiterated until they were followed by every patient (full mouth plaque and gingival index score<1).

***CLINICAL PARAMETERS AT BASELINE (i.e. at the time of implant loading), 3 & 6 MONTHS POST LOADING***

After the completion of the initial phase of therapy, the suitability of sites for the study was confirmed and following clinical parameters were assessed

- Modified Plaque Index at 3 months ($mPI_3$), Modified Plaque Index at 6 months ($mPI_6$) (Mombelli et al. 1987)
- Modified Sulcus Bleeding Index at Baseline ($mBI_B$), Modified Sulcus Bleeding Index at 3 months ($mBI_3$), Modified Sulcus Bleeding Index at 6 months ( $mBI_6$) (Mombelli et al. 1987)
- Probing Pocket Depth at Baseline ($PPD_B$), Probing Pocket Depth at 3 months ($PPD_3$), Probing Pocket Depth at 6 months ($PPD_6$)
- Implant Mobility at 6 months ($M_6$)

**mPI&mGI*(Mombelli et al. 1987)***

After softly air-drying the area, a mouth mirror and a dental explorer were used to inspect the plaque. There were 4 surfaces inspected (Facial, Lingual, Mesial & Distal).

| **Score** | **Mombelli et al (mPI)** |
|---|---|
| 0 | No detection of plaque |
| 1 | Plaque only recognized by running a probe across the smooth marginal surface of the implant |
| 2 | Plaque can be seen by the naked eye |
| 3 | Abundance of soft matter |

| **Score** | **Mombelli et al (mGI)** |
|---|---|
| 0 | No bleeding when a periodontal probe is passed along the mucosal margin adjacent to the implant |
| 1 | Isolated bleeding spots visible |
| 2 | Blood forms a confluent red line on mucosalmargin |
| 3 | Heavy or profuse bleeding |

**PROBING MEASUREMENTS**

With the help of **UNC-15 graduated carbon fibre periodontal probe**, **PPD (probing pocket depth)** measurements were taken at baseline, three and six months post loading and they were recorded to the nearest millimeter. PPD of all the 4 sites (mesio-buccal, mid-buccal, disto-buccal and mid-lingual) per tooth were examined and the site with deepest findings was included in the study.

- ✓ ***(PPD)****: Probing pocket depth (PPD) was measured using the gingival margin as reference*

Due to certain drawbacks in the usage of stents, customized acrylic stents weren't employed to test the reproducibility of the probing angulation at three time points (baseline, three and six months). Stents are usually stored for about 6 months or more and are frequently made of self-cure acrylic resins, which have a higher degree of dimensional instability than heat-cure acrylic (due to a higher residual free monomer ratio of 3-5% in self-cure acrylic as opposed to 0.2-0.5% in heat-cure acrylic)[58]. Clinically, it is not practical to create occlusal stents with a heat-cure acrylic. Therefore, self-cure acrylic stents typically get distorted after being stored for a lengthy period of time (≥6 months). This alters the adaptation of the stent to the

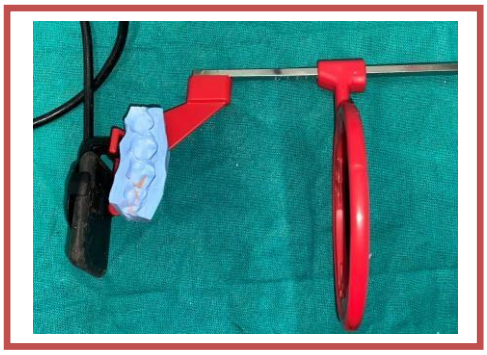
occlusal surface, which then alters the probing angulation, and thereby impeding the standardization process.

***RADIOGRAPHIC PARAMETERS AT BASELINE, 3& 6 MONTHS POST LOADING***

**RVG Imaging:**

Due to its reproducibility, an IOPA image was obtained with a paralleling technique using a Unicorn$^{TM}$ RVG sensor, a Geno-ray$^{TM}$ Portable Xray Unit X-II, an XCP RVG-sensor Positioner, and a IOPA- Dental Xray Grid (Navadha$^{TM}$). We employed a Vinyl Polysiloxane impression material (Flexceed$^{TM}$) and Elastomeric impression material (Neopure$^{TM}$) for the purpose of bite registration in every case to ensure reproducibility of bite at six months (owing to its long-term stability) [Figure-1].


Vinyl Polysiloxane and Elastomeric impression material



Assembly of RVG Sensor positioner and bite registered impression for Standardization

RVG Sensor with mm Grid

Figure-1: Armamentarium & procedure for obtaining well standardized radiograph.

Image obtained were analysed for radiographic parameter- MARGINAL BONE-LOSS (MBL) as below [Figure-2].

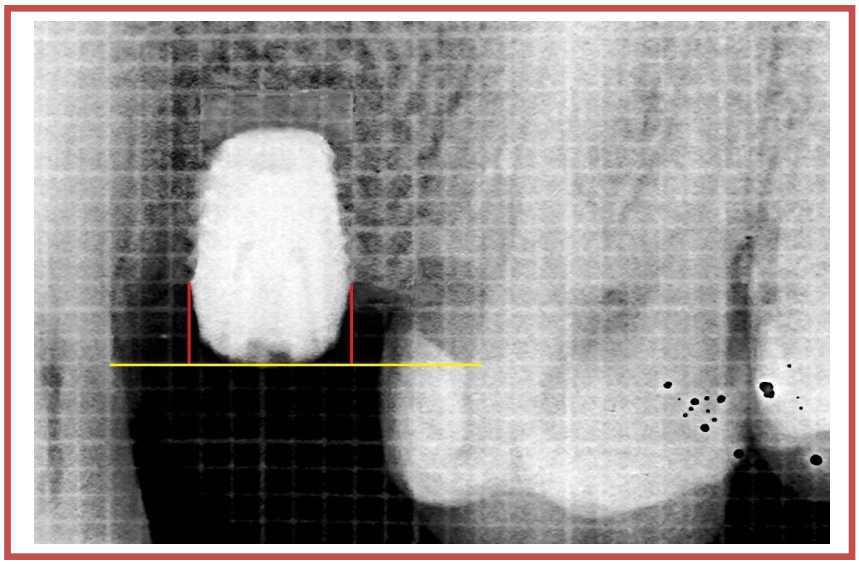


Figure-2: Radiographic measurements

***Marginal Bone Loss (MBL3 & MBL6):***.

Yellow line drawn on the coronal surface of the implant were used as a reference line. Two perpendicular red lines were drawn on the mesial and distal sides of the implants to the first bone-to-implant contact. Comparative measurements of the mesial and distal crestal bone levels close to implants were made to the nearest 0.1 mm. The amount of crestal bone loss for each patient was calculated using the average data from the minimum of three readings. Subtracting the previous bone level from the most recent one gave the bone loss.

***SURGICAL PROCEDURE [Photoplates 1-5]***

After the collection of Clinical data, surgical preparation was carried out, which comprised pre-operative scrubbing of face with 5% povidone iodine (5% Betadine™) and mouth rinsing with 10 ml of 0.2% chlorhexidine digluconate solution (Hexidine™). The surgical procedure was conducted with asepsis maintained. The surgical area was anaesthetized with a nerve block using 2% Xylocaine and adrenaline at a dose of 1:200,000 (Astra Zeneca Pharma India Ltd.). Using a #15 BP blade, a mid-crestal incision was performed to give clear visual access to the operative site. A #12 BP blade was also used wherever it was required. A P24G Glickman periosteal elevator was then used to elevate a buccal and lingual mucoperiosteal flap (Hu-friedy™).

**IMPLANT SYSTEM –**

NR Line (Straight head) is a standard dental implant marketed by Dentium™. Its connection is internal, with a square shape. It's a Tissue level implant. Its body is tapered with v shaped threads. Its head is straight and has microthreads. Its head has a bevel. Its apex has a dome shape, doesn't have a hole, and has grooves. It requires a screwdriver of square shape [Figure-3].

**Technical Features**

- Level: Tissue Level
- Connection Type: Internal
- Connection Shape: Square
- Head Shape: Straight
- Head Microthreads: Yes
- Body Shape: Tapered
- Body Threads: V Shaped
- Apex Shape: Dome
- Apex Hole: No Hole
- Apex Grooves: Yes

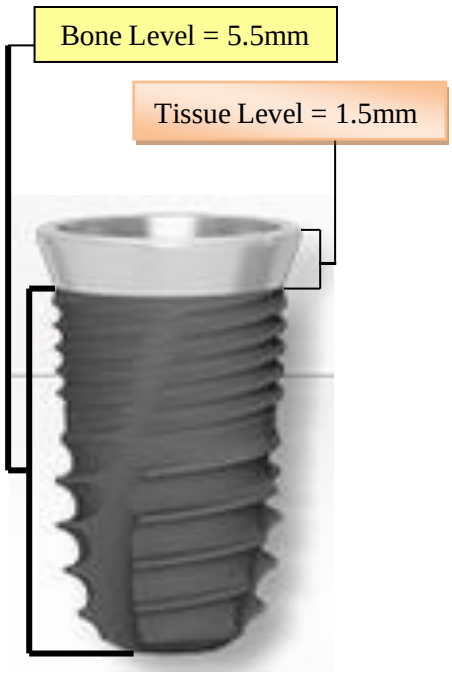



**Figure-3: Schematic drawing of NR Line (Dentium™) dental implant system and its macro-geometric features**

- *Abutment Screw*
  - Ø1.9mm hole size for abutment screw
- *Platform- switched Design*
  -It may be beneficial in marginal bone preservation
- *S.L.A. Surface* (Sandblasted with Large grits and Acid etched)
  -Easy application combined with simplified GBR procedure on narrow ridges
- *Internal Conical Connection*
  - Internal conical connection between implant and abutment interface allows tight sealing
- *Double-Threaded, Tapered Body Design*
  -Easy and fast insertion can be done due to the double-threaded straight body design
- *Apical Design*
  - The 3-blade self-tapping design can minimize bone destruction
  -The flat end design reduces bone perforation risk

***CONTENTS OF NR Line (Narrow Ridge) IMPLANT KIT***

***Dentium$^{TM}$ Co.,Ltd. (South Korea)***

1. Drill
   - First Guide Drill (Ø2.6 29mm, Ø2.6 35mm)
   - Final Drill (Ø3.0, Ø3.6, Ø4.3, Ø5.0 each in 29mm & 35mm length)

2. Parallel Pin

3. Path Pin

4. Square Driver (hand piece, Ratchet)

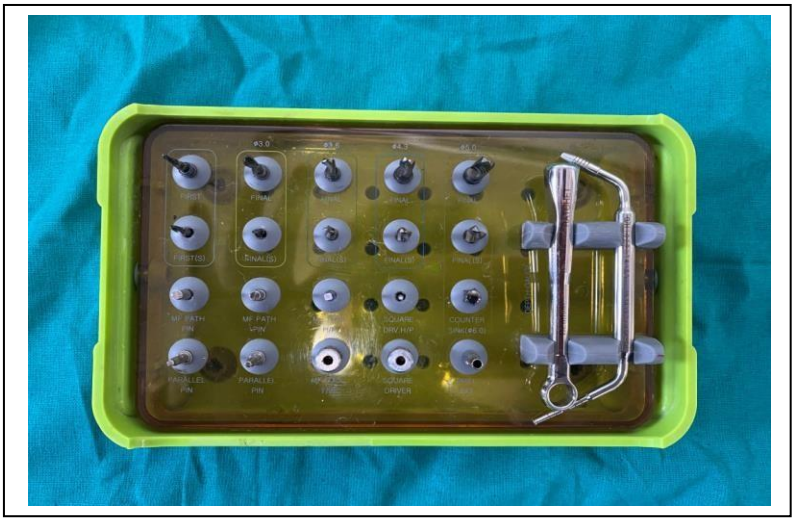
5. Adapter (hand piece, Ratchet)

6. Drill Extension

7. Torque wrench

8. Ratchet

9. Depth Gauge



The pilot drill, at the speed of 1100 rpm, was used to begin the osteotomy, applying intermittent pressure to the bone for one to two seconds before releasing it. The high-speed drill had a cutting edge at the apical part and was used alongside external saline irrigation, which was attached to a hand piece. After drilling it to the depth of chosen implant length, parallel pin was placed in the drilled site to check meso-distal angulation relative to the adjacent tooth and anatomical structure. A periapical radiograph was taken to control vertical and horizontal locations in relation to nearby critical anatomical structures. After achieving and verifying proper angulation and depth of the drilled site, the osteotomed site was gradually enlarged with the help of final drill in relation to the diameter of chosen implant.

Then the selected implant (NR Line Implants, Dentium$^{TM}$, South Korea ) measuring 5.0 x 5.5 mm was manually inserted into the osteotomy with the help of adapter(ratchet). The cover screw (healing plug) was then placed on the implant.

***POST-SURGICAL CARE***

Patient was prescribed antibiotic regimen of Amoxicillin 500mg TDS 5-days. In order to manage post- operative discomfort and oedema, non-steroidal anti-inflammatory medicine was prescribed (acelofenac 100mg BD 3-days, followed by SOS).

The patient was instructed to use chlorhexidine digluconate mouthrinse (0.2%) 12 hourly for four weeks following surgery.

The patient were given all post operative instructions in written form.

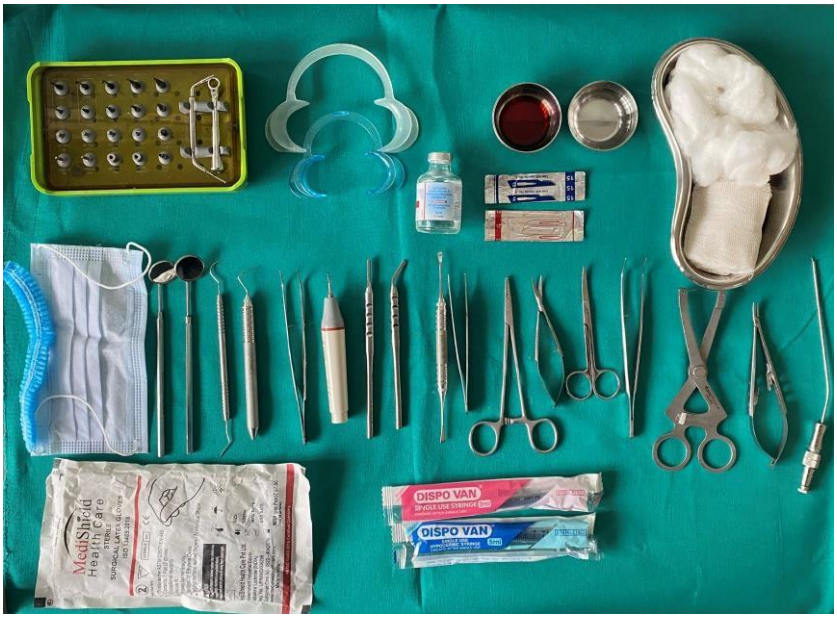
***POST-SURGICAL FOLLOW UP AND MAINTENANCE***

One week after surgery, the sutures were removed. The 2% povidone-iodine solution was then used to carefully clean the surgical wound. Each patient was told to start mechanical oral hygiene, which comprised using a soft toothbrush and brush their teeth gently, and to refrain from using any kind of interdental-cleaning tools in the surgically treated area for four weeks after the procedure.

For re-evaluation, each patient were recalled after intervals of two weeks, one month, two months and eventually six months from the date of surgery. Additionally, oral hygiene instructions were reinforced at each visit, and plaque was removed in-office as needed as part of the postoperative care.

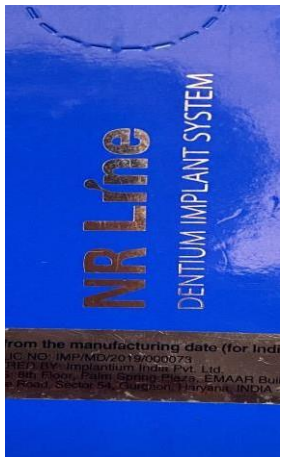
Six months of healing time were required before implants were uncovered after the flaps were retracted. Gingival abutments were placed, flaps re-adapted and sutured. Definitive impressions were taken after two weeks of soft tissue healing. Crowns made of porcelain fused to metal (PFM) were delivered in less than two weeks. Thereafter, at each subsequent recall appointment, occlusal modifications were done (if any?) and prosthetic restorations were inspected for loosening, chipping, or other prosthetic issues.

As previously indicated, baseline, three month and six month measurements of all clinical and radiographic parameters were made.



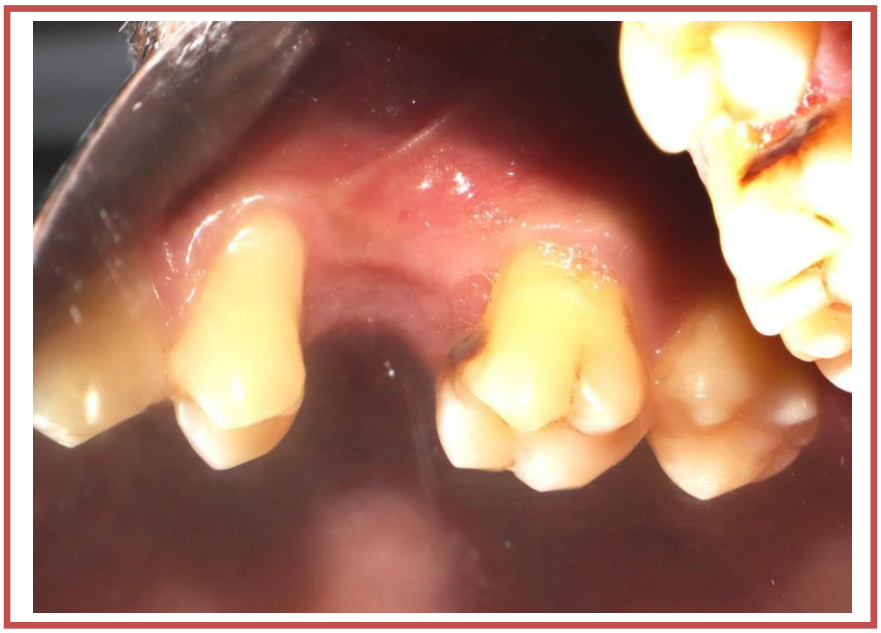

**Surgical Armamentarium**


**Physiodispenser with Handpiece (W&H$^{TM}$)**

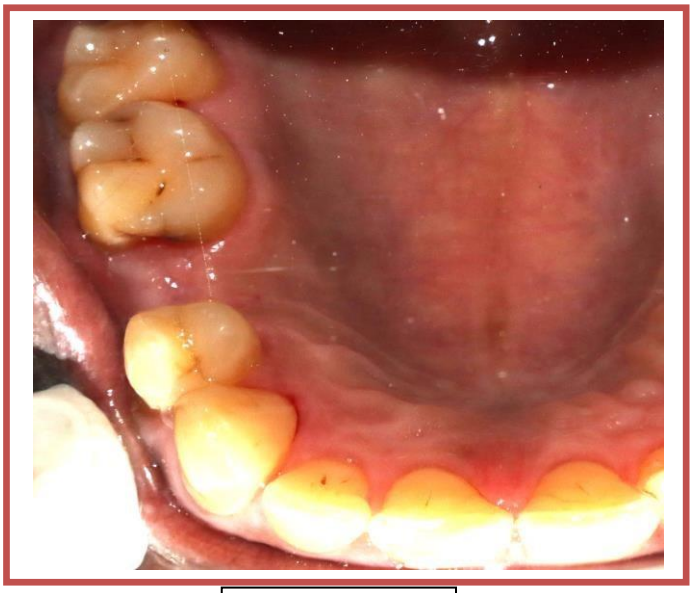




**Packaging of NR Line (Dentium$^{TM}$) Dental implant system**

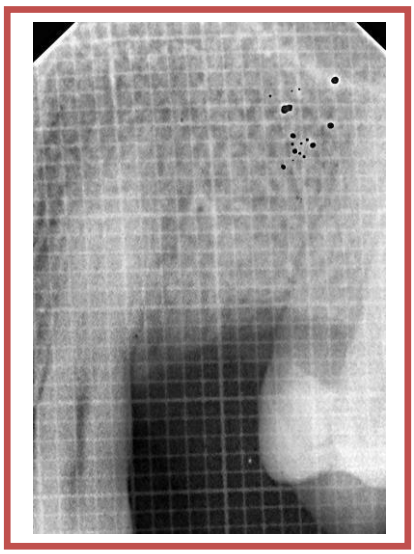
**PHOTOPLATE-1: SURGICAL KIT & ARMAMENTARIUM**



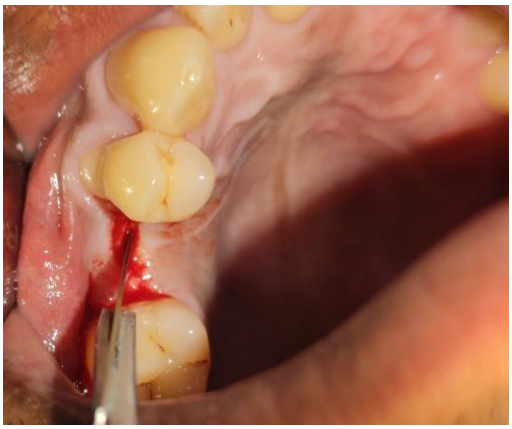
**Buccal view**



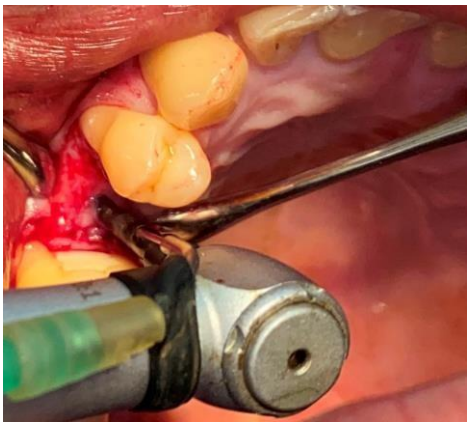
**Occlusal view**



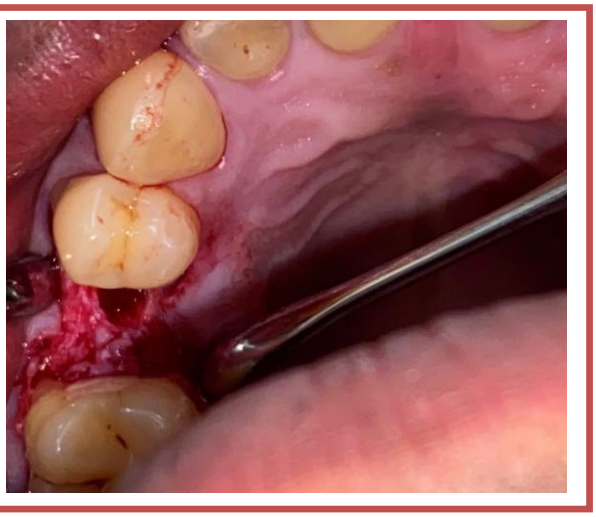
**PHOTOPLATE-2: PRE-OPERATIVE CLINICAL & RADIOGRAPHIC IMAGE OF THE CASE**



**Mid-crestal Incision with #15 BP Blade**



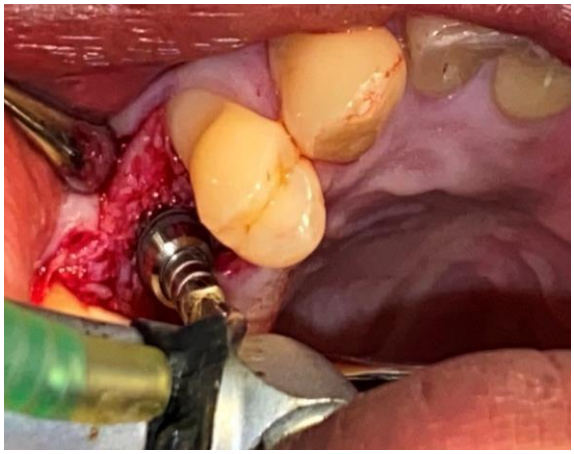
**Drilling Initiated with pilot**



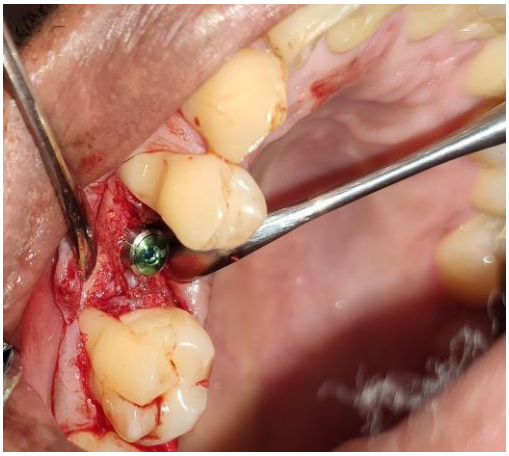
**Osteotome hole in progress**

**Guide-pin for judging Parallelism**

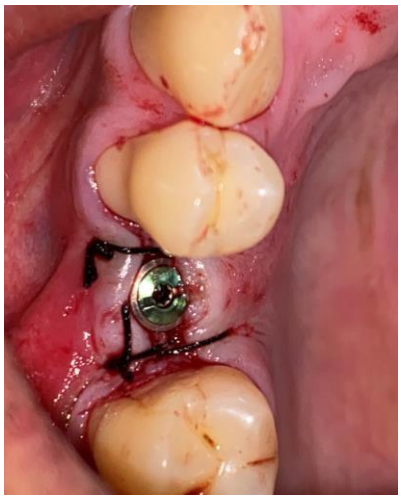
**PHOTOPLATE-3: Surgical Procedure**



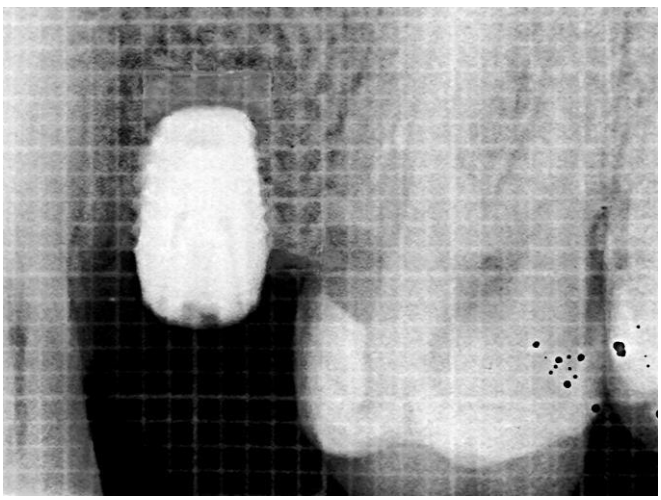
**Insertion of Implant**



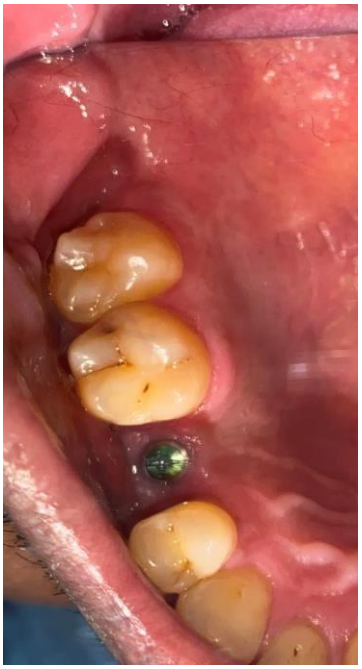
**Implant Inserted**

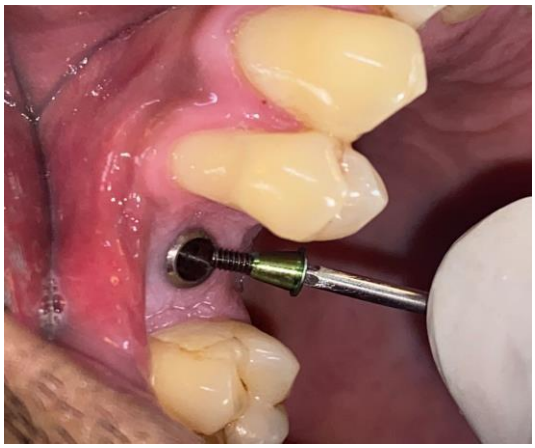


**Direct Loop Sutures in Place**

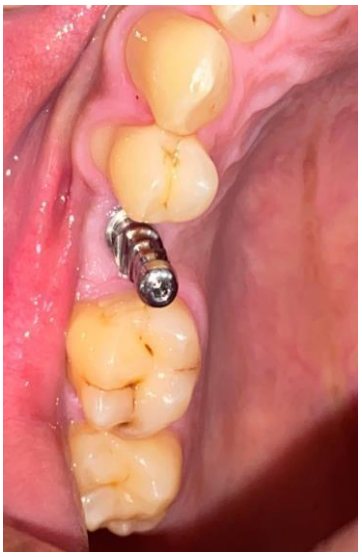


**PHOTOPLATE-4: Post-operative Clinical & Radiographic Image**

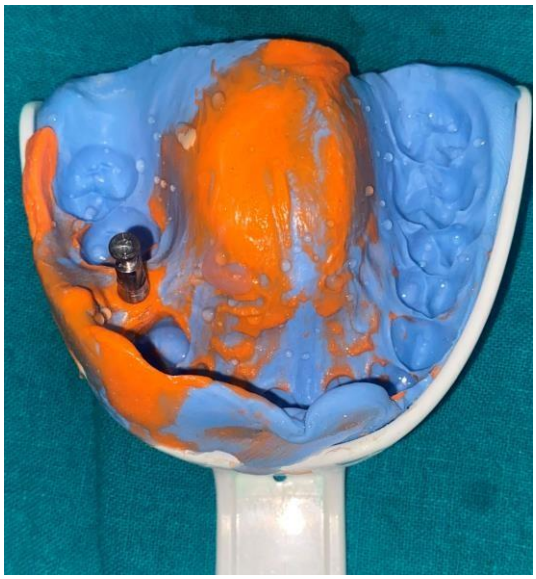




**Removal of Cover screw**

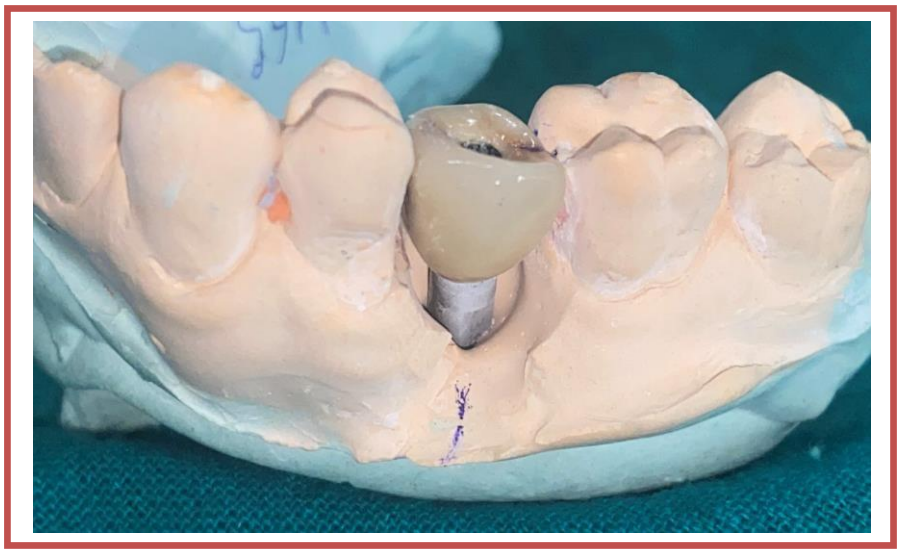


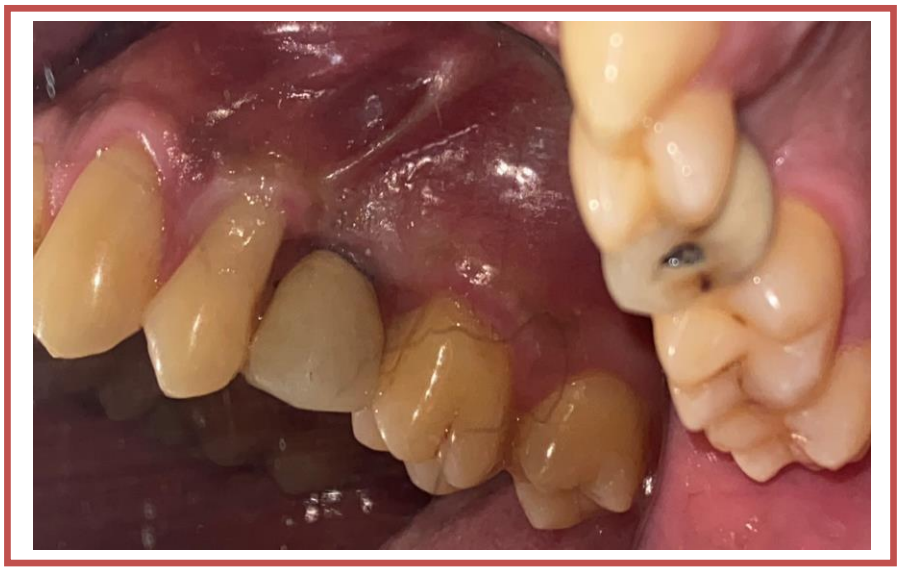
**Impression coping placed**

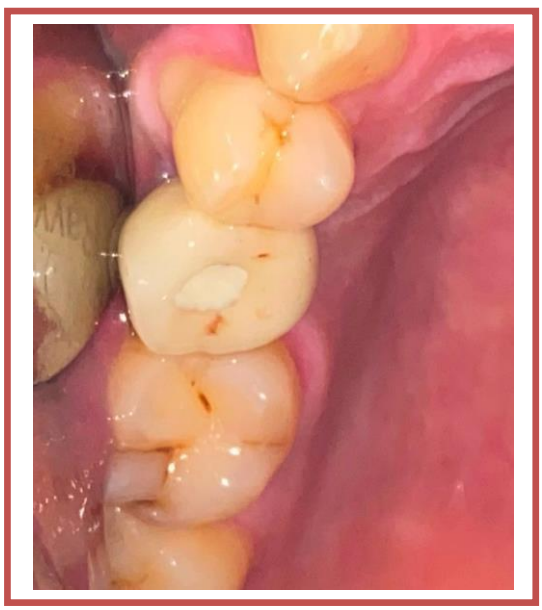


**Definitive Impressions made**

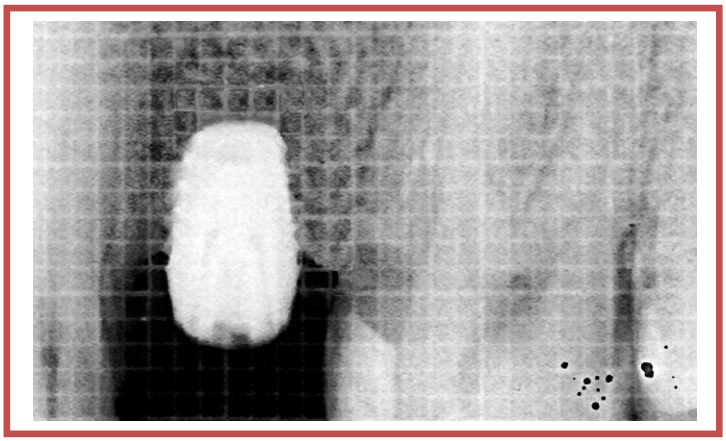
**PHOTOPLATE-5a: Second Stage Procedure**



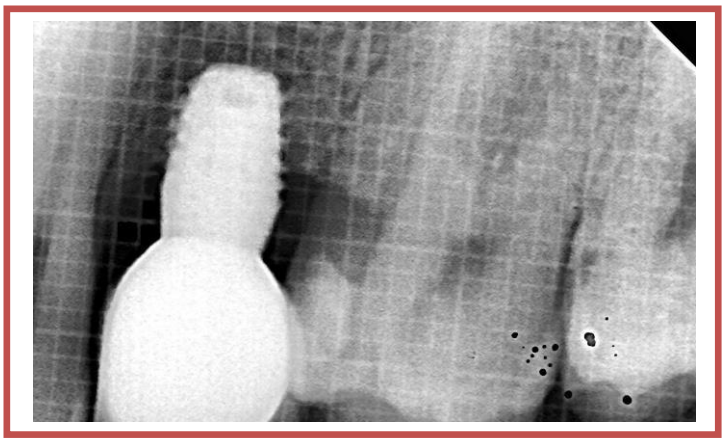




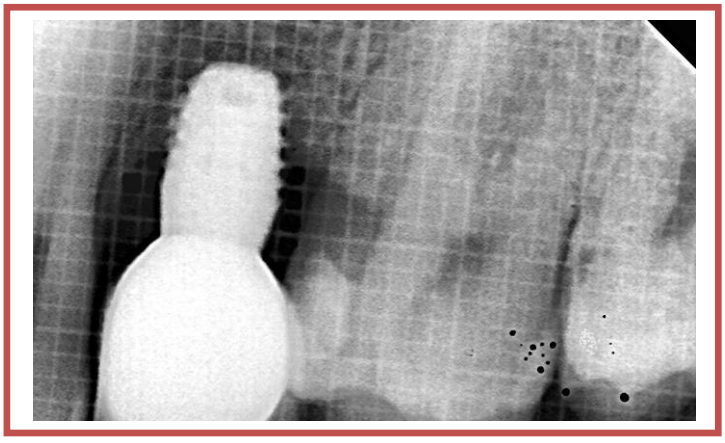
**PHOTOPLATE-5b: Prosthesis Fabrication**



**at Baseline**



**at 3 Months**



**at 6 Months**

**PHOTOPLATE-5c: Radiographic Images at Baseline, 3 months post loading and 6 months post loading.**

# RESULTS AND OBSERVATIONS

The effectiveness of ultra-short dental implants in comparison to conventional dental implants is assessed in the current clinical and radiological study. A total of 10 implants were placed in patients of either sex who were older than 25 years of age and had a partially edentulous ridge with at least 8mm horizontal dimension at the crest. The recruitment process included individuals without any contraindications for minor oral surgery, local or general anaesthesia, or titanium allergy, as well as those whose important structures, such as the maxillary sinus, was at least 6.5mm away from the crest of the ridge. Patients with previously placed conventional implants in the posterior maxillary edentulous arch were deemed the control group, while patients with the insertion of ultra short implants of 5.0 x 5.5 mm were called the experimental group.

Marginal bone loss, modified Plaque index, modified Sulcus Bleeding Index, and probing pocket depth around implants were the clinical and radiographic characteristics evaluated at baseline, three months post loading, and six months post loading. The goal of this study was to compare the outcome indicators between two groups (Group A and Group B ).

**Basic Characteristics**

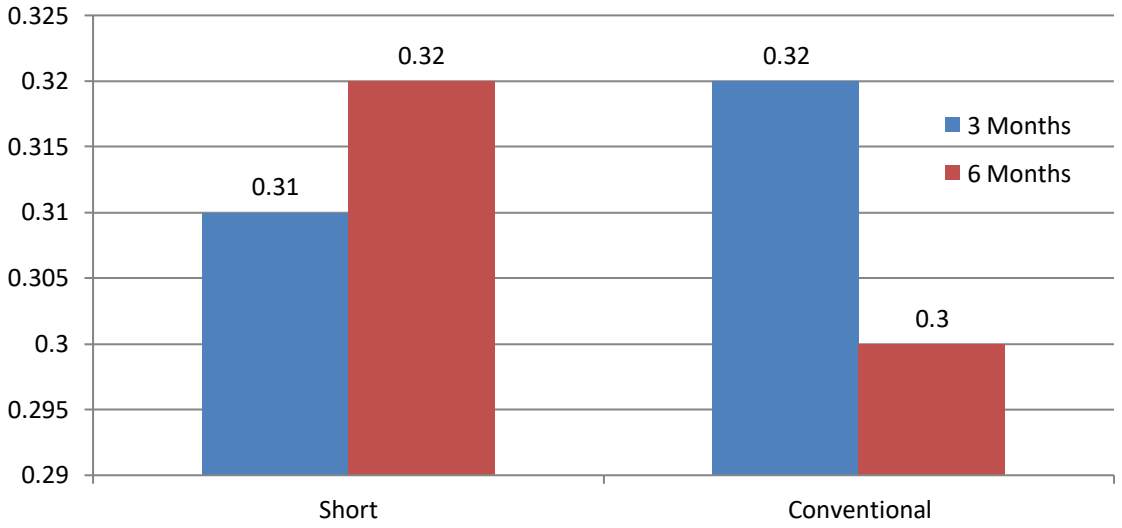
The basic characteristics like Marginal bone loss, Probing pocket depth, Plaque and Sulcus bleeding index were assessed and compared between the two groups (Short and Conventional Implants). When the comparison was made between the two groups for the basic characteristics, the difference between the two groups was found to be statistically non-significant (p value more than 0.05). The non-significant difference between the two groups signifies that both the groups were similar with reference to basic characteristics.

**Table-1: Assessment of changes in Marginal Bone Loss at the follow up periods in Short Implant group and Conventional Implant group**

| | 3 Months | 6 Months | Mean Diff | P value | Significance |
|---|---|---|---|---|---|
| Short | 0.31 | 0.32 | 0.01 | 0.867 | NS |
| Conventional | 0.32 | 0.30 | 0.02 | 0.867 | NS |

**P value ≥ 0.05 (non-significant level)**

**Graph-1**




With respect to changes in marginal bone loss at the follow up periods, in Ultra-shortimplant group, the increase in the mean marginal bone loss was found to be statistically non-significant between 3 months and 6 months (p = 0.867) .

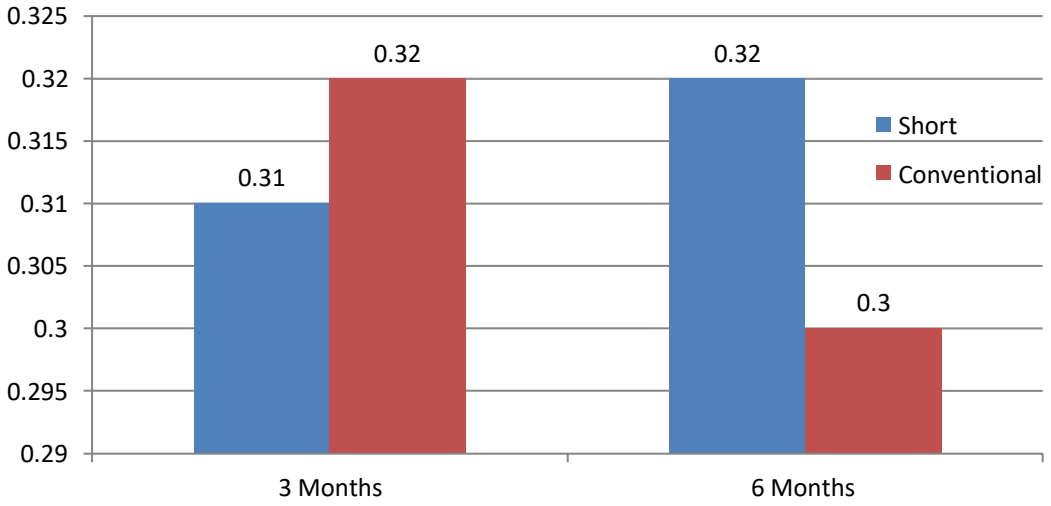
With respect to changes in marginal bone loss at the follow up periods, in conventional group, the decrease in the mean marginal bone loss was found to be statistically non- significant between 3 months and 6 months (p = 0.867).

**Table-2: Comparison of Short Implant and Conventional Implant at the follow-up periods with respect to Marginal Bone Loss**

| PARAMETER | FOLLOW UP PERIOD | IMPLANT | Mean | Std. Deviation | Mean difference | P value |
|---|---|---|---|---|---|---|
| **Marginal Bone Loss** | 3 months | Short | 0.31 | 0.08 | 0.01 | 0.612 (NS) |
| | | Conventional | 0.32 | 0.15 | | |
| | 6 months | Short | 0.32 | 0.10 | 0.02 | 0.612 (NS) |
| | | Conventional | 0.30 | 0.13 | | |

**P value ≥0.05 (non-significant level)**

**Graph-2**




At 3 months follow up, the mean marginal bone loss is found to be 0.31 in ultra-short implant group and 0.32 in the conventional implant group. The difference of 0.01 between the mean values of the two groups is found to be statistically not significant (p = 0.612) indicating that, there is no statistically significant difference between ultra-short implant and conventional implant with respect to marginal bone loss at 3 months follow up period

At 6 months follow up, the mean marginal bone loss is found to be 0.32 in the short implant group and 0.30 in the conventional implant group. The difference of 0.02 between the mean values of the two groups is found to be statistically non-significant (p = 0.612) indicating that, there is statistically no significant difference

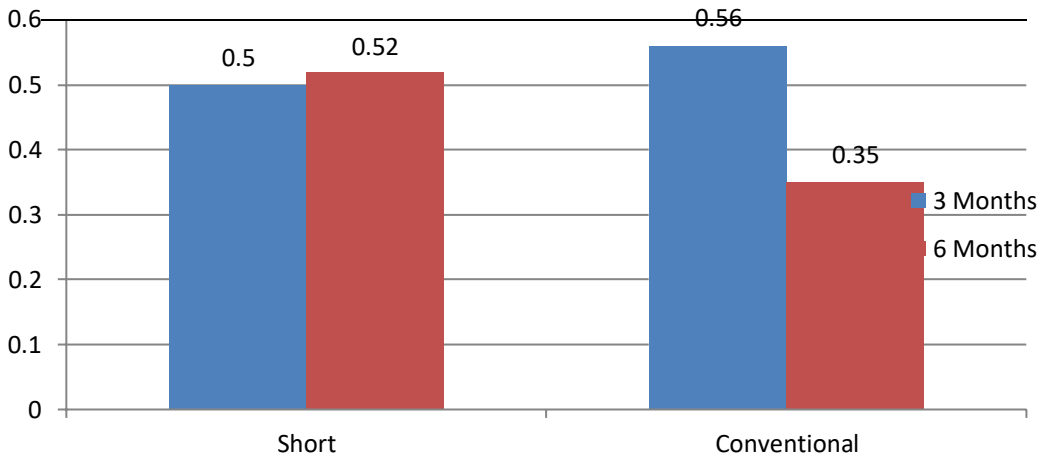
between short implant and conventional implant with respect to marginal bone loss at 6 months follow up period.

**Table-3: Assessment of Modified Plaque Index at the follow up periods in Short Implant group and Conventional Implant group**

| | 3 Months | 6 Months | Mean Diff | P value | Significance |
|---|---|---|---|---|---|
| Short | 0.50 | 0.52 | 0.02 | 0.652 | Non-Sig |
| Conventional | 0.56 | 0.35 | 0.21 | **0.001*** | Significant |

**P value ≥ 0.05 (non-significant level)**

**Graph-3**




With respect to changes in Plaque Index at the follow up periods, in ultra-short implant group, the increase in the Plaque Index values was found to be statistically non-significant between 3 months and 6 months (p = 0.652) .

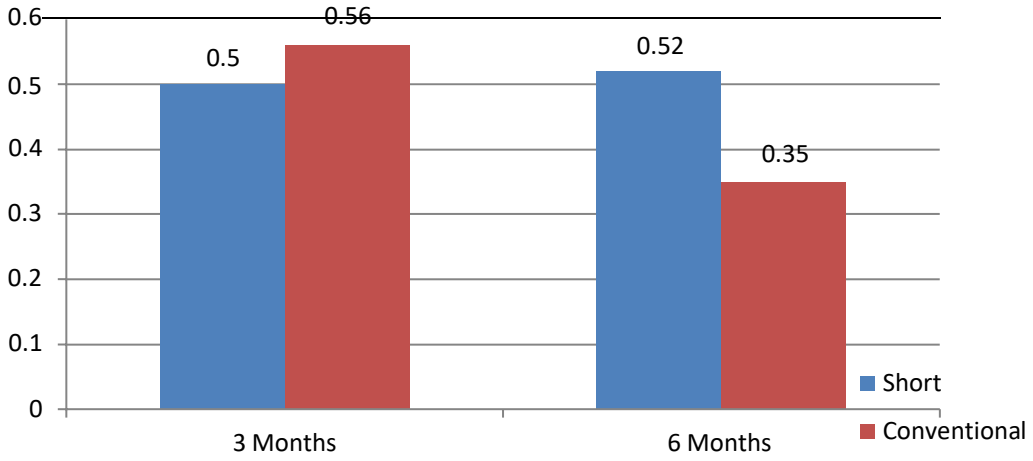
With respect to changes in Plaque Index at the follow up periods, in conventional group, the decrease in the Plaque Index values was found to be statistically significant between 3 months and 6 months (p = **0.001***).

**Table-4: Comparison of Short Implant and Conventional Implant at the follow up periods with respect to Modified Plaque Index (Mombelli et al. 1987)**

| PARAMETER | FOLLOW UP PERIOD | IMPLANT | Mean | Std. Deviation | Mean difference | P value |
|---|---|---|---|---|---|---|
| Plaque Index | 3 months | Short | 0.50 | 0.52 | 0.06 | 0.234 (NS) |
| | | Conventional | 0.56 | 0.16 | | |
| | 6 months | Short | 0.52 | 0.51 | 0.17 | 0.153 (NS) |
| | | Conventional | 0.35 | 0.11 | | |

**P value ≥ 0.05 (non significance level)**

**Graph-4**




At 3 months follow up, the mean plaque index is found to be 0.50 in ultra- short implant group and 0.56 in the conventional implant group. The difference of 0.06 between the mean values of the two groups is found to be statistically not significant (p = 0.234) indicating that, there is no statistically significant difference between short implant and conventional implant with respect to plaque index at 3 months follow up period.

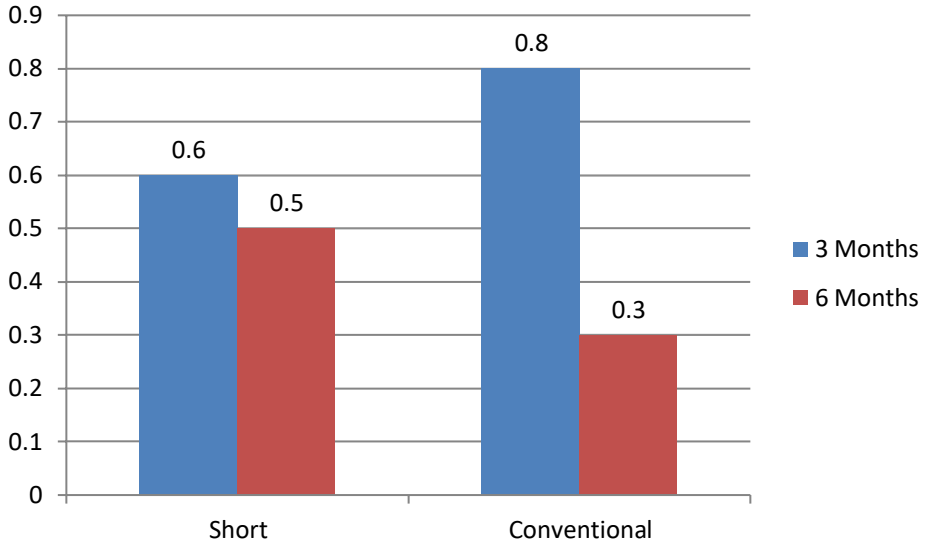
At 6 months follow up, the mean plaque index is found to be 0.52 in the short implant group and 0.35 in the conventional implant group. The difference of 0.17 between the mean values of the two groups is found to be statistically not significant ( p = 0.153) indicating that, there is no statistically significant difference between short implant and conventional implant with respect to plaque index at 6 months follow up period.

**Table-5: Assessment of modified Sulcus Bleeding Index at the follow up periods in Short Implant group and Conventional Implant group**

| | 3 Months | 6 Months | Mean Diff | P value | Significance |
|---|---|---|---|---|---|
| Short | 0.60 | 0.50 | 0.10 | 0.525 | Non-Sig |
| Conventional | 0.80 | 0.30 | 0.50 | **0.001*** | Significant |

**P value ≥ 0.05 (non-significant level)**

**Graph-5**




With respect to changes in Sulcus Bleeding Index at the follow up periods, in ultra- short implant group, the decrease in the Sulcus Bleeding Index values was found to be statistically non-significant between 3 months and 6 months (p = 0.525).

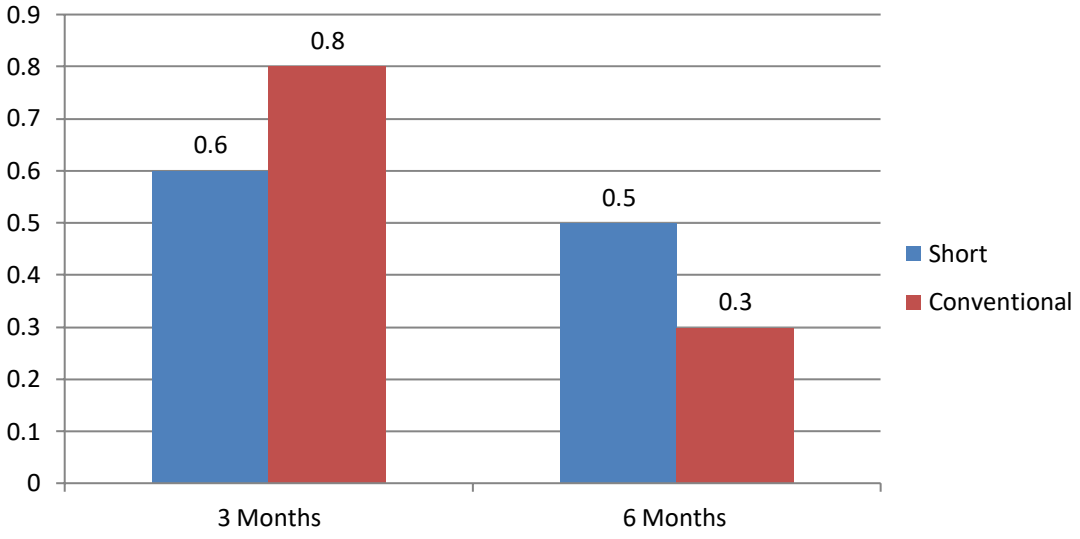
With respect to changes in Sulcus Bleeding Index at the follow up periods, in conventional group, the decrease in the Sulcus Bleeding Index values was found to be statistically significant between 3 months and 6 months(p = **0.001***).

**Table-6: Comparison of Short Implant and Conventional Implant at the followup periods with respect to Modified Sulcus Bleeding Index mBI (Mombelli et al. 1987)**

| PARAMETER | FOLLOW UP PERIOD | IMPLANT | Mean | Std. Deviation | Mean difference | P value |
|---|---|---|---|---|---|---|
| Gingival value | 3 months | Short | 0.60 | 0.51 | 0.20 | 0.178 NS |
| | | Conventional | 0.80 | 0.42 | | |
| | 6 months | Short | 0.50 | 0.52 | 0.20 | 0.178 NS |
| | | Conventional | 0.30 | 0.48 | | |

**P value ≥ 0.05 (non-significant level)**

**Graph-6**




At 3 months follow up, the mean bleeding score was found to be 0.60 in ultra- short implant group and 0.80 in the conventional implant group. The difference of 0.20 between the mean values of the two groups is found to be statistically not significant (p = 0.178) indicating that, there is no statistically significant difference between short implant and conventional implant with respect to mBI at 3 month follow up period.

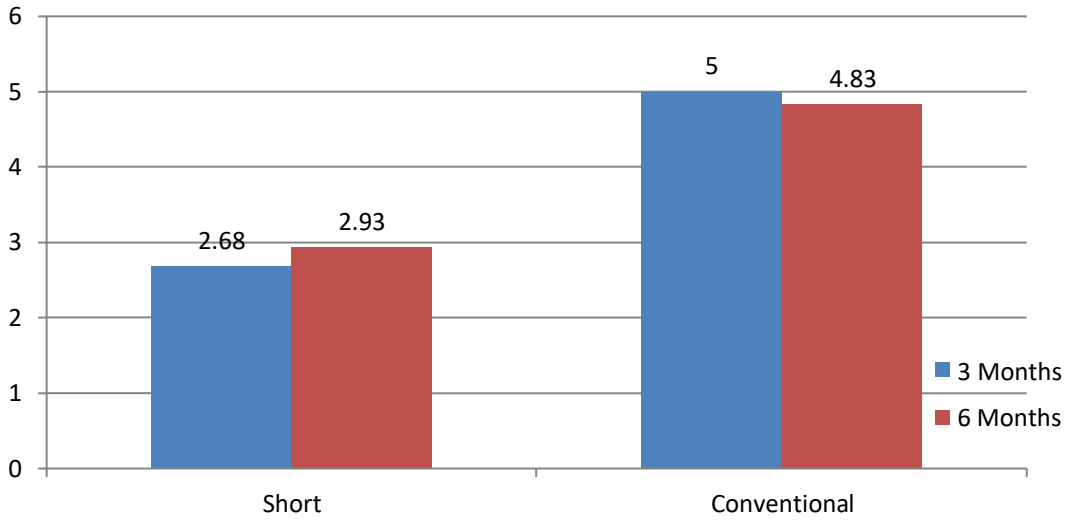
At 6 months follow up, the mean bleeding score was found to be 0.50 in the short implant group and 0.30 in the conventional implant group. The difference of 0.20 between the mean values of the two groups is found to be statistically not significant ( p = 0.178) indicating that, there is no statistically significant difference between short implant and conventional implant with respect to mBI at 6 months follow up period.

**Table-7: Assessment of Probing Pocket Depth at the follow up periods in Short Implant group and Conventional Implant group**

| | 3 Months | 6 Months | Mean Diff | P value | Significance |
|---|---|---|---|---|---|
| Short | 2.68 | 2.93 | 0.25 | 0.089 | Non-Sig |
| Conventional | 5.00 | 4.83 | 0.17 | 0.155 | Non-Sig |

**P value ≥ 0.05 (non significant level)**

**Graph: 7**




With respect to changes in probing depth at the follow up periods, in short implant group, the increase in the probing depth values was found to be statistically non-significant between 3 months and 6 months (p = 0.089) .

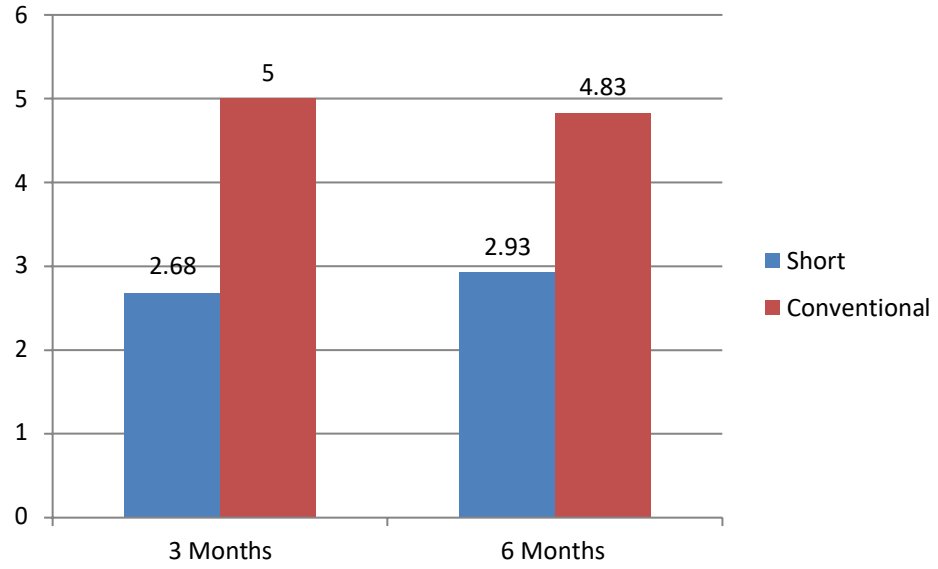
With respect to changes in probing depth at the follow up periods, in conventional group, the decrease in the probing depth values was found to be statistically non-significant between 3 months and 6 months (p=0.155).

**Table-8: Comparison of Short Implant and Conventional Implant at the follow up periods with respect to Probing Pocket Depth**

| Parameter | Follow Up period | Implant | Mean | Std. Deviation | Mean difference | P value |
|---|---|---|---|---|---|---|
| Probing Pocket Depth | 3 months | Short | 2.68 | 0.57 | 2.32 | **0.001*** (Sig) |
| | | Conventional | 5.00 | 0.35 | | |
| | 6 months | Short | 2.93 | 0.55 | 1.90 | **0.001*** (Sig) |
| | | Conventional | 4.83 | 0.39 | | |

**P value < 0.05(* significant level )**

**Graph: 8**




At 3 months follow up, the mean probing pocket depth is found to be 2.68mm in ultra- short implant group and 5.00(±0.35)mm in the conventional implant group. The difference of 2.32mm between the mean values of the two groups is found to be statistically significant (p = **0.001***) indicating that, there is statistically significant difference between ultra-short implant and conventional implant with respect to probing pocket depth at 3 months follow up period.

At 6 months follow up, the mean probing pocket depth is found to be 2.93mm in ultra- short implant group and 4.83(±0.39) in the conventional implant group. The difference of 1.90 between the mean values of the two groups is found to be statistically significant ( p = **0.001***) indicating that, there is statistically significant difference between ultra-short implant and conventional implant with respect to probing pocket depth at the 6 month follow up period

# DISCUSSION

The purpose of this direct comparison was to assess and compare the clinical performance of a single ultra-short implant with a single standard implant (data of which were taken from past research). According to the study's design, the various treatments and population that were chosen may have contributed to heterogeneity at baseline (immediately after loading) in the clinical and radiographic parameters.

The definition of short implants is a subject of ongoing debate in the literature. Short implants were characterized as those with a length of 11, 10, or 8 mm or less[59]. Implants of length 5.5-mm and diameter 5.0-mm were employed in the current investigation as Ultra short implants. Lemos et al. (2016) concluded that there was no significant difference in prosthesis failures, complications, or marginal bone loss (MBL) between short (8-mm) and standard implants in their systematic review. The authors drew the conclusion that short implants are a reliable alternative for treating posterior jaws. They did add, however, that short implants with lengths of less than 8 mm (4–7 mm) should be utilized with caution as they carry higher failure risks than conventional implants[44]. These findings are in line with recent studies[60] that show great success and survival rates for short implants. A survival rate of 95% was reported for 6-mm implants in a prospective, 5-year follow-up clinical study[61]. The results of the present study showed that 10 ultra-short implants (5.5 mm) had a cent per cent survival rate, slightly defying the success rates of 8 mm short implants as observed by Lemos et al. (2016), and that there was no statistically significant difference ($p \geq 0.05$) between the short implants and conventional implants (based on data from earlier studies). These outcomes were consistent with earlier research, which showed that the mean survival rate for short implants (8 mm) was 96.13% and the mean survival rate for standard implants was 97.28%[62]

## Comparison of Short Implant and Conventional Implant at the follow-up periods with respect to Marginal Bone Loss

When marginal bone loss (MBL) was taken into account, the average MBL for Ultra-short implants at 3 and 6 months was 0.31 and 0.32 mm respectively when compared to baseline. We did not find any statistically significant ($p \geq 0.05$) difference at different time interval (Table-1, Graph-1). This means that there was not much MBL upto 6 months.

The average MBL for Conventional implants at 3 and 6 months was 0.32 and 0.30 mm respectively when compared to baseline. We did not find any statistically significant ($p \geq 0.05$) difference at different time interval (Table-1, Graph-1). Again these figures means that if implants are placed with proper skill than it doesn't cause much bone loss.

When MBL for Ultra-short implants were compared with Conventional implants at 3 months and 6 months respectively, we did not find any statistically significant ($P \geq 0.05$) differences (Table-2, Graph-2).

It can be inferred from the above results that Ultra-short implants are as successful as conventional implants in terms of marginal bone loss. Shorter implants with a broader diameter (as cited by various researchers[63]), various bio-friendly engineering designs and surface treatment might have lead to these figures.

**Comparison of Short Implant and Conventional Implant at the follow-up periods with respect to Modified Plaque Index (Mombelli et al. 1987)**

When modified Plaque Index (mPI) was taken into account, the average mPI for Ultra-short implants at 3 and 6 months was 0.50 and 0.52 respectively. We did not find any statistically significant ($p \geq 0.05$) difference at different time interval (Table-3, Graph-3). This means plaque did not get deposited over the implant supported crown and the oral hygiene was good.

The average mPI for Conventional implants at 3 and 6 months was 0.56 and 0.35 respectively. There was statistically significant ($p = \mathbf{0.001*}$) reduction of plaque at 6 months (Table-3, Graph-3). It can be hypothesized that proper brushing technique was not introduced initially but later due to some reinforcement, plaque reduction was seen.

When mPI for Ultra-short implants were compared with Conventional implants at 3 months and 6 months respectively, we did not find any statistically significant ($P \geq 0.05$) differences.

It can be inferred from the above results that the plaque score was similar in both the groups, i.e., the overall hygiene was good (Table-4, Graph-4). Although the

assessment value of mPI for conventional implant in 3 months and 6 months seems to be statistically significant, but the score of 0.56 as well as 0.35, both fall under good oral hygiene score so we can say that this value is biologically insignificant. The overall hygiene of patients with conventional implant remained good.

**Comparison of Short Implant and Conventional Implant at the follow-up periods with respect to Modified Sulcus Bleeding Index mBI (Mombelli et al. 1987)**

When modified Sulcus Bleeding Index (mBI) was taken into account, the average mBI for Ultra-short implants at 3 and 6 months was 0.60 and 0.50 respectively. We did not find any statistically significant ($p \geq 0.05$) difference at different time interval (Table-5, Graph-5). This means that there was no gingival bleeding when periodontal probe was passed along the mucosal margin adjacent to the implant.

The average mBI for Conventional implants at 3 and 6 months was 0.80 and 0.30 respectively. There was statistically significant ($p = \mathbf{0.001^*}$) reduction of bleeding score at 6 months (Table-5, Graph-5). It can be hypothesized that proper brushing technique was not introduced initially but later due to some reinforcement, reduction in bleeding score was seen.

When mBI for Ultra-short implants were compared with Conventional implants at 3 months and 6 months respectively, we did not find any statistically significant ($P \geq 0.05$) difference.

It can be inferred from the above results that the bleeding score was similar in both the groups (Table-6, Graph-6). Overall there was no bleeding found in both the groups.

**Comparison of Short Implant and Conventional Implant at the follow up periods with respect to Probing Pocket Depth**

When Probing Pocket Depth (PPD) was taken into account, the average PPD for Ultra-short implants at 3 and 6 months was 2.68 and 2.93mm respectively. There

was no statistically significant ($p \geq 0.05$) difference between these two time interval (Table-7, Graph-7).

The average PPD for Conventional implants at 3 and 6 months was 5.00 and 4.83mm respectively. There was no statistically significant ($p \geq 0.05$) reduction of Pocket depth at 6 months (Table-7, Graph-7).

When PPD for Ultra-short implants were compared with Conventional implants at 3 months and 6 months respectively, we found statistically significant ($P < 0.05$) differences (Table-8, Graph-8).

There was more PPD incase of Conventional implants. It might be because the Ultra-short implants were a tissue level implant and Conventional implants were a bone level implant. One more reason can be because of the fact that many conventional implants were placed along with bone grafting or sinus augmentation procedures. All these complicated supplementary surgery were avoided during the placement of Ultra short implant thereby simplifying healing. In our study, there was no comparision from baseline to three and six months for PPD. This is a limitationof this study for PPD parameter

This study also assessed implant mobility at 6 months post loading. Using the blunt end of two mouth mirrors, we tested implant mobility. The RFA device was not employed in the current study to evaluate mobility.

It can be inferred that Ultra-short implant success was 100% in terms of mobility.

All in all, there were no post-operative problems, implant mobility issues, tissue reactions that weren't favourable, infections, or atypical patient experiences. The complication rates of conventional implants were higher in earlier studies, but they were statistically non-significant when compared to short implants[61]. It should be highlighted that the majority of conventional implants that required bone grafting or sinus augmentation procedures for implant installation presented complex situations. In cases where there is insufficient vertical dimension of bone that prevents placement of a conventional long implant without supplementary surgery, a short implant can be placed without much effort. Such type of short implant placement

simplifies healing as seen in the current report with a 5.5-mm long implant and also makes it a more affordable treatment option.

In the current investigation, the effects of the crown-to-implant ratio were not examined. Although larger crown-to-implant ratios have been found to increase the MBL in biomechanical investigations, however there has been no such observations seen in clinical studies[64]. The ratio of the crown to implant cannot be viewed as a risk factor for biological complications or failure of implant, according to a systematic review by Quaranta et al. in 2014.

Recent review found that periodontal indices like mBI, mPI, and PPD are useless diagnostic tools for assessing implants and should be avoided since they harm the tissues around implants unnecessarily[65].

The limitations in present study were that there was no control group using conventional implants and therefore it made the direct comparision naive. We took the standard implant data from relevant prior investigations. The study's power was further diminished by the tiny sample size of only 10 Ultra-short implants, which was another significant flaw. Additionally, the crown-to-implant (C/I) ratio and RFA quotient were not taken into account as comparative criteria in the current analysis. With reference to the maxillary arch, the predictability and stability of the x 5.5mm Ultra-short implants requires more additional randomised controlled clinical trials with a larger sample size.

# CONCLUSION

Based on the observations, statistical analysis, and discussion backed by data, the following conclusion has been drawn:

1. Implant survival rates, marginal bone loss, and complications did not significantly differ between standard and ultra-short implants.
2. Both the groups had non-significant statistics in terms of, modified Plaque Index, modified Sulcus Bleeding Index and Probing Pocket Depths.
3. Single unit restoration, with respect to maxillary arch, can be supported by Ultra-short dental implants.
4. The traditionally used conventional root form dental implants can only be used when there is sufficient alveolar bone volume; otherwise, complex surgical procedures such as additional bone grafting or augmentation procedures would be necessary.

Short implants do offer a viable restorative option for edentulous areas, especially in regions with compromised or insufficient alveolar bone volume, like the posterior maxillary arch. Due to the small number of implants employed in the study and the paucity of meaningful published data, comparisons have proven challenging. In difficult cases, this can be a cost-effective treatment option, but long-term monitoring and more implants are needed to demonstrate its effectiveness.

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# APPENDICES

**ANNEXURE -**

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

## INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Assessment of the Success of Short Implants In Maxillary Arch: A Clinico-Radiographic Study."** Submitted by **Dr Jigme Palzor Denzongpa** Post graduate student from the **Department of Periodontology** as part of MDS Curriculum for the academic year 2020-2023 with the accompanying proforma was reviewed by the Institutional Research Committee present on **11th October 2021** 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

**ANNEXURE -2**

# 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 IX$^{th}$ Institutional Ethics Sub-Committee**

**IEC Code: 18** **BBDCODS/04/2022**

**Title of the Project:** Assessment of the Success of Short Implants In Maxillary Arch: A Clinico-Radiographic Study.

**Principal Investigator:** Dr Jigme Palzor Denzongpa **Department:** Periodontology

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

**Type of Submission:** New, MDS Project Protocol

Dear Dr Jigme Palzor Denzongpa,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 07$^{th}$ April, 2022.

| | | |
|---|---|---|
| 1. | Dr. Lakshmi Bala<br>Member Secretary | Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow |
| 2. | Dr. Amrit Tandan<br>Member | Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow |
| 3. | Dr. Rana Pratap Maurya<br>Member | Reader, Department of Orthodontics, BBDCODS, Lucknow |
| 4. | Dr. Akanksha Bhatt<br>Member | Reader, Department of Conservative Dentistry & Endodontics, 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

**(Dr. Lakshmi Bala)**
Member-Secretary
IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

**(Dr. Puneet Ahuja)**
Principal
BBDCODS

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

## Babu Banarasi Das College of Dental Sciences
**(Babu Banarasi Das University)**
**BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

1. **Title of the project**: ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC STUDY

2. Name of the department/ address of the investigator: Dept. of Periodontology, BBDCODS

3. Name of Faculty (Guide/Co-Guide) with designation and department:
Dr. Vandana A Pant (Professor) – Guide
Department of Periodontology and Implantology

Dr. Sunil C Verma (Reader) – Co Guide
Department of Periodontology and Implantology

4. Date of approval by Institutional Research Committee (IRC) (PI enclose approval letter along with finally approved research proposal):

5. Sources of funding: Self

6. Study related information:

(i) Place of Study: BBDCODS
Kindly attach Consent letter from the concerned faculty/clinician of other Institution.

(ii) *In-vitro studies on human subjects*: Please specify if it is body fluid blood/tissues/ teeth.
Not Applicable
(a) Bile, Saliva etc. [ ]
(b) Teeth, please specify type [ ]
(c) Tissue, please specify type [ ]
(d) Use of stored or left over specimens [ ]
(e) Any other [ ]

(iii) *In-vivo* study on human subjects:
(a) Intervention [ ]
(b) Drugs [ ]
(c) Implants [✓]
(d) Any other e.g. X-rays/ultrasound/etc [✓]

(vi) Vulnerable subjects.
(a) Pregnant Woman [ ]
(b) Elderly [ ]
(c) Terminally ill [ ]
(d) Physically/ mentally challenged [ ]
(e) Children under 18 [ ]
(f) Students [ ]
(g) Orphans [ ]

(vii) Survey of human subject:
(a) Verbal questionnaire [ ]
(b) Non- invasive examination [ ]
(c) Invasive procedures [✓]

(viii) SEA (Severe Adverse Events) reporting:
(a) Is there a plan for reporting of adverse events [ ]
If yes it will be done to Institution (s) [ ] IEC [ ] All [✓]

7. Ethical issues involved in the study:
   *Less than minimal risk/ minimal risk/ more than minimal risk to the study subjects (for guidance please consult ICMR guidelines 2006)*

8. Do you need exemption from obtaining Informed Consent from study subject – if so give justifications
   In following cases exemption can be requested:
   a. Audits of educational practices.
   b. Research on microbes cultured in the laboratory.
   c. Research on immortalized cell lines.
   d. Computer Simulation and Dental Materials
   e. Analysis of data freely available in public domain.
   f. Any other.

9. Whether Consent forms and Participant Information Document in English and in Hindi are enclosed? Yes

10. Conflict of interest for any other investigator(s) (if yes, please explain in brief)

11. We the undersigned, have read and understood this protocol and hereby agree to conduct the study in accordance with this protocol and to comply with all requirements of the ICMR guidelines (2006)

Signature of the Investigator: Date: 09/03/22

09/03/2022 9/3/22

Signature of the Guide & Co- Guide of the Department: Date: 09/03/2022

09/03/22.

Signature of the Head of the Department: Date 09/03/2022

(Note: The investigator must provide information to the subjects in a simple language, and it should address the subjects, in a dialogue format)

**ANNEXURE -3**

**Babu Banarasi Das College of Dental Sciences**
**(Babu Banarasi Das University)**
**BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

**Consent Form (Hindi)**

अध्ययन का शीर्षक: मैक्सिलरी आर्क में लघु प्रत्यारोपण की सफलता का आकलन: क्लिनिक-रेडियोग्राफिक अध्ययन

स्टडी नंबर.....

विषय का पूरा ब्राम .....

जन्म तिथि/आयु .....

विषय का पता.....

फोन नंबर। और ई-मेल पता .....

योग्यता .....

व्यवसाय: छात्र / स्वरोजगार / सेवा / गृहिणी / अन्य (कृपया उपयुक्त के रूप में टिक करें)

विषय की वार्षिक आय.....

नाम और नामांकित व्यक्ति (ओं) और विषय के साथ उसका संबंध ( प्रयोजन के लिए मुकदमे से संबंधित मौत के मामले में मुआवजा)।

1. मैं पुष्टि करता हूं कि मैंने प्रतिभागी सूचना दस्तावेज दिनांक . को पढ़ और समझ लिया है.....उपरोक्त अध्ययन के लिए और प्रश्न पूछने का अवसर मिला है। या मुझे अन्वेषक द्वारा अध्ययन की प्रकृति के बारे में बताया गया है और मुझे प्रश्न पूछने का अवसर मिला है।

2. मैं समझता हूं कि अध्ययन में मेरी भागीदारी स्वैच्छिक है और बिना किसी दबाव के स्वतंत्र इच्छा के साथ दी गई है और मैं बिना कोई कारण बताए और अपनी चिकित्सा देखभाल या कानूनी अधिकारों को प्रभावित किए बिना किसी भी समय वापस लेने के लिए स्वतंत्र हूं।

3. मैं समझता हूं कि परियोजना के प्रायोजक, प्रायोजक की ओर से काम करने वाले अन्य, नैतिकता समिति और नियामक प्राधिकरणों को वर्तमान अध्ययन और किसी भी आगे के शोध के संबंध में मेरे स्वास्थ्य रिकॉर्ड को देखने के लिए मेरी अनुमति की आवश्यकता नहीं होगी। इसके संबंध में आयोजित किया जा सकता है, भले ही मैं परीक्षण से हट जाऊं। हालांकि, मैं समझता हूं कि तीसरे पक्ष को जारी या प्रकाशित किसी भी जानकारी में मेरी पहचान प्रकट नहीं की जाएगी।

4. मैं इस अध्ययन से उत्पन्न होने वाले किसी भी डेटा या परिणामों के उपयोग को प्रतिबंधित नहीं करने के लिए सहमत हूं, बशर्ते ऐसा उपयोग केवल वैज्ञानिक उद्देश्यों के लिए हो।

5. मैं भविष्य के शोध के लिए संग्रहीत नमूने (दांत/ऊतक/रक्त) के उपयोग की अनुमति देता हूं।

हाँ [ ] नही [ ] लागू नहीं [ ]

6. मैं उपरोक्त अध्ययन में भाग लेने के लिए सहमत हूं। मुझे जटिलताओं और दुष्प्रभावों के बारे में समझाया गया है, यदि कोई हो, और उन्हें पूरी तरह से समझ लिया है। मैंने प्रतिभागी/स्वयंसेवक के मुझे दिए गए सूचना दस्तावेज को भी पढ़ और समझ लिया है।

विषय/कानूनी रूप से स्वीकार्य प्रतिनिधि के हस्ताक्षर (या अंगूठे का निशान):.....

हस्ताक्षरकर्ता का नाम..... तारीख .....

अन्वेषक के हस्ताक्षर ..... तारीख.....

अध्ययन अन्वेषक का नाम ..... तारीख.....

गवाह के हस्ताक्षर..... तारीख.....

गवाह का नाम .....

पीआईडी की एक हस्ताक्षरित प्रति और विधिवत भरे हुए सहमति फॉर्म विषय के हस्ताक्षर/अंगूठे का निशान या कानूनी रूप से दिनांक.....

स्वीकार्य प्रतिनिधि

## Babu Banarasi Das College of Dental Sciences

**(Babu Banarasi Das University)**
**BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

**Consent Form (English)**

Title of the Study: **ASSESSMENT OF THE SUCCESS OF SHORT IMPLANTS IN MAXILLARY ARCH: A CLINICO-RADIOGRAPHIC 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 [ ] Not Applicable [ ]**
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 Date……..

Acceptable representative

**ANNEXURE -4**

**Babu Banarasi Das College of Dental Sciences**
**(A constituent institution of Babu Banarasi DasUniversity)**
**BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

**Participant Information Document (PID)**

**1. Study title**

Assessment of the success of short implants in maxillary arch: a clinico-radiographic study.

**2. Invitation paragraph**

You are being invited to take part in a research study, Before you decide it is important for you to understand why the research/study is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your treating physician/family doctor if you wish.. Ask us if there is anything that is not clear or if you would like more information. Take time to decide wether or not you wish to take part.

**3. What is the purpose of the study?**

The purpose of this study is to

i. Measure the Marginal Bone Level (MBL) at baseline and at 6 months post loading.
ii. To measure the implant mobility after 6 months.
iii. To measure the modified Plaque Index (mPI), modified Gingival Index (mGI) and Probing Pocket Depth (PPD) at baseline and at 6 months post loading.
iv. To compare the final results with pre-existing data of conventional implants.

**4. Why have I been chosen?**

You have been chosen for this study as you are fulfilling the required criteria for this study.

**5. Do I have to take part?**

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 are still free to withdraw at any time and without giving a reason.

**6. What will happen to me if I take part?**

You will have to come four to five times. In the first visit the implant site will be prepared followed by the measurement of Implant stability and mobility after four to six months. As a volunteer, your responsibility will be to arrive on time.

**7. What do I have to do?**

Apart from certain changes in the dietary intake post surgery for couple of days, You do not have to change your regular lifestyles for the investigation of the study.

**8. What is the procedure that is being tested?**

The procedure will involve placement of short implants in the back region of upper jaw where teeth are missing. Dental implants are screw like components that look and function like a real tooth rooth. Crown will be placed on these implants after 4-6 months of implant placement. Various tests will then be conducted during crown placement and 6 months post crown placement to evaluate marginal bone loss and mobility. You are expected to follow all the instructions given by the doctors.

**9. What are the interventions for the study?**

Pre-surgical: Before the surgery is conducted intra oral periapical radiographs (RVG) with grid and OPG radiograph will be obtained.

Surgical: Implant site will be prepared under 2% lignocaine with adrenaline and full thickness flap will be raised for osteotomy as per the required condition. After implant is placed, its mobility is checked with the use of two blunt instruments. Mobility will be checked again after 4-6 months during crown placement and then further after 6 months of crown placement.

Post-Surgical: medication will be prescribed such as antibiotics, Nsaids.

**10. What are the side effects of taking part?**

Some of the associated side effects of dental implants are pain and discomfort that lasts

not more than two weeks, minor bleeding. Incase of infection or any numbness or loosening of the implants, report immediately to the doctor.

**11. What are the possible disadvantages and risks of taking part?**

i. Failure rate of implants is more in heavy smokers and is directly related to tobacco use.

ii. Osteoporosis is a disease of decreased bone mass, increased bone weakness, and have more potential to fracture resulting in poor implant stability therefore higher chances of implant failure.

iii. Diabetic patients are more susceptible to infection and this could be a reason for implant failure.

**12. What are the possible benefits of taking part?**

By taking part in this study you will help us to assess the success of short implants in maxillary arch(upper jaw).

**13. What if new information becomes available?**

If additional information becomes available during the course of the research, you will be informed about the changes that can happen to 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.

**14. What happens when the research study stops?**

If the study stops/finishes before the stipulated time, then the reason for the same will be explained to the patients.

**15. What if something goes wrong?**

If any severe adverse event occurs, or something goes wrong during the study, the complaints will be handled by reporting to the institution (BBDCODS), and Institute ethical community.

**16. Will my taking part in this study be kept confidential?**

Yes, it will be kept confidential.

**17. What will happen to the results of the research study?**

The results of the study will be used to assess the success of short implants in upper jav (maxillary arch). Your identity will be kept confidential in case of any report/publications.

**18. Who is organizing the research?**

This research study is organized by the academic institution (BBDCODS).

**19. Will the results of the study be made available after study is over?**

Yes. If the patient wishes, the result of the study will be made available to him/her.

**20. Who has reviewed the study?**

The study has been reviewed and approved by the Head of the Dept, and the IEC/IRC o the institution.

**21. Contact for further information**

Dr. Jigme Palzor Denzongpa
Department of Periodontology
Babu Banarasi Das College of Dental Sciences.
Lucknow-226028
Mob- 6297988469

Dr. Vandana A Pant (Professor)
Department of Periodontology
Babu Banarasi Das College of Dental Sciences.
Lucknow-226028
Mob-9935957775

Dr. Sunil C Verma (Reader)
Department of Periodontology
Babu Banarasi College of Dental Sciences.
Lucknow-226028
Mob-9335928773

**Dr. Mona Sharma (HOD)**
**Department of** Periodontology
**Babu Banarasi Das College of Dental sciences**
Lucknow-226028
Mob-9984**110444**
bbdcods.iec@gmail.com

Signature of PI.....

Name.....

Date.....

**Babu Banarasi Das College of Dental Sciences**

**(A constituent institution of Babu Banarasi DasUniversity)**

**BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

प्रतिभागी सूचना दस्तावेज (पीआईडी)

1. अध्ययन शीर्षक

मैक्सिलरी आर्च में शॉर्ट इम्प्लांट्स की सफलता का आकलन: एक क्लिनिको-रेडियोग्राफिक अध्ययन।

2. आमंत्रण पैराग्राफ

आपको एक शोध अध्ययन में भाग लेने के लिए आमंत्रित किया जा रहा है, निर्णय लेने से पहले आपके लिए यह समझना महत्वपूर्ण है कि शोध/अध्ययन क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया निम्नलिखित जानकारी को ध्यान से पढ़ने के लिए समय निकालें और यदि आप चाहें तो मित्रों, रिश्तेदारों और अपने इलाज करने वाले चिकित्सक/पारिवारिक चिकित्सक के साथ इस पर चर्चा करें। हमसे पूछें कि क्या कुछ स्पष्ट नहीं है या यदि आप अधिक जानकारी चाहते हैं। यह तय करने के लिए समय निकालें कि आप भाग लेना चाहते हैं या नहीं।

3. अध्ययन का उद्देश्य क्या है?

इस अध्ययन का उद्देश्य है

i बेसलाइन पर और लोड होने के 6 महीने बाद हड्डी के स्तर (एमबीएल) को मापें।

ii. 6 महीने के बाद इम्प्लांट की गतिशीलता को मापने के लिए।

iii. संशोधित प्लाक इंडेक्स (एमपीआई), संशोधित जिंजिवल इंडेक्स (एमजीआई) और प्रोबिंग पॉकेट डेप्थ (पीपीडी) को बेसलाइन पर और 6 महीने बाद लोडिंग को मापने के लिए।

iv. पारंपरिक प्रत्यारोपण के पहले से मौजूद डेटा के साथ अंतिम परिणामों की तुलना करना।

4. मुझे क्यों चुना गया है?

आपको इस अध्ययन के लिए चुना गया है क्योंकि आप इस अध्ययन के लिए आवश्यक मानदंडों को पूरा कर रहे हैं।

5. क्या मुझे भाग लेना है?

शोध में आपकी भागीदारी पूरी तरह से स्वैच्छिक है। यदि आप करते हैं, तो आपको यह दिया जाएगा सूचना पत्रक रखने के लिए और सहमति प्रपत्र पर हस्ताक्षर करने के लिए कहा जाएगा। अध्ययन के दौरान आप किसी भी समय और बिना कोई कारण बताए वापस लेने के लिए स्वतंत्र हैं।

6. यदि मैं भाग लेता हूँ तो मेरा क्या होगा?

चार-पांच बार आना पड़ेगा। पहली मुलाकात में इम्प्लांट साइट तैयार की जाएगी और उसके बाद चार से छह महीने के बाद इम्प्लांट की स्थिरता और गतिशीलता का मापन किया जाएगा। एक स्वयंसेवक के रूप में, आपकी जिम्मेदारी समय पर पहुंचने की होगी।

7. मुझे क्या करना होगा?

सर्जरी के बाद कुछ दिनों के लिए आहार सेवन में कुछ बदलावों के अलावा, अध्ययन की जांच के लिए आपको अपनी नियमित जीवन शैली में बदलाव करने की आवश्यकता नहीं है।

8. किस प्रक्रिया का परीक्षण किया जा रहा है?

इस प्रक्रिया में ऊपरी जबड़े के पिछले क्षेत्र में छोटे प्रत्यारोपण की नियुक्ति शामिल होगी जहां दांत गायब हैं। डेंटल इम्प्लांट्स स्क्रू जैसे कंपोनेंट्स होते हैं जो असली टूथ रूट की तरह दिखते हैं और काम करते हैं। इम्प्लांट लगाने के 4-6 महीने बाद इन इम्प्लांट्स पर क्राउन लगाया जाएगा। सीमांत हड्डी हानि और गतिशीलता का मूल्यांकन करने के लिए क्राउन प्लेसमेंट के दौरान और क्राउन प्लेसमेंट के 6 महीने बाद विभिन्न परीक्षण किए जाएंगे। आपसे डॉक्टरों द्वारा दिए गए सभी निर्देशों का पालन करने की अपेक्षा की जाती है।

9. अध्ययन के लिए क्या हस्तक्षेप हैं?

प्री-सर्जिकल: सर्जरी से पहले ग्रिड के साथ इंट्रा ओरल पेरीएपिकल रेडियोग्राफ (आरवीजी) और ओपीजी रेडियोग्राफ प्राप्त किया जाएगा।

सर्जिकल: एड्रेनालाईन के साथ 2% लिग्नोकेन के तहत इम्प्लांट साइट तैयार की जाएगी और आवश्यक स्थिति के अनुसार ऑस्टियोटॉमी के लिए पूर्ण मोटाई फ्लैप उठाया जाएगा। इम्प्लांट लगाने के बाद, दो कुंद उपकरणों के उपयोग से इसकी गतिशीलता की जाँच की

जाती है। क्राउन प्लेसमेंट के दौरान 4-6 महीने के बाद और फिर क्राउन प्लेसमेंट के 6 महीने बाद फिर से गतिशीलता की जांच की जाएगी।

पोस्ट-सर्जिकल: दवाएं निर्धारित की जाएंगी जैसे एंटीबायोटिक्स, एनएसएड्स।

10. भाग लेने के दुष्प्रभाव क्या हैं?

दंत प्रत्यारोपण के कुछ संबद्ध दुष्प्रभाव दर्द और बेचैनी हैं जो बनी रहती हैं

दो सप्ताह से अधिक नहीं, मामूली रक्तस्राव। संक्रमण या किसी सुन्नता या प्रत्यारोपण के ढीले होने की स्थिति में, तुरंत डॉक्टर को रिपोर्ट करें।

11. भाग लेने के संभावित नुकसान और जोखिम क्या हैं?

i. भारी धूम्रपान करने वालों में प्रत्यारोपण की विफलता दर अधिक होती है और इसका सीधा संबंध तंबाकू के उपयोग से होता है।

ii. ऑस्टियोपोरोसिस हड्डियों के द्रव्यमान में कमी, हड्डियों की कमजोरी में वृद्धि, और फ्रैक्चर की अधिक संभावना वाली बीमारी है जिसके परिणामस्वरूप खराब इम्प्लांट स्थिरता होती है इसलिए इम्प्लांट के विफल होने की संभावना अधिक होती है।

iii. मधुमेह के रोगी संक्रमण के प्रति अधिक संवेदनशील होते हैं और यह प्रत्यारोपण की विफलता का एक कारण हो सकता है।

12. भाग लेने के संभावित लाभ क्या हैं?

इस अध्ययन में भाग लेकर आप मैक्सिलरी आर्च (ऊपरी जबड़े) में छोटे प्रत्यारोपण की सफलता का आकलन करने में हमारी मदद करेंगे।

13. क्या होगा यदि नई जानकारी उपलब्ध हो जाती है?

यदि शोध के दौरान अतिरिक्त जानकारी उपलब्ध हो जाती है, तो आपको अध्ययन में होने वाले परिवर्तनों के बारे में सूचित किया जाएगा। यदि आप वापस लेने का निर्णय लेते हैं, तो आपका शोधकर्ता आपकी वापसी की व्यवस्था करेगा। यदि आप अध्ययन जारी रखने का निर्णय लेते हैं, तो आपसे एक अद्यतन सहमति फॉर्म पर हस्ताक्षर करने के लिए कहा जा सकता है।

14. जब शोध अध्ययन बंद हो जाता है तो क्या होता है?

यदि अध्ययन निर्धारित समय से पहले रुक जाता है / समाप्त हो जाता है, तो इसका कारण रोगियों को समझाया जाएगा।

15. अगर कुछ गलत हो जाए तो क्या होगा?

यदि कोई गंभीर प्रतिकूल घटना होती है, या अध्ययन के दौरान कुछ गलत हो जाता है, तो संस्थान (बीबीडीसीओडीएस), और संस्थान नैतिक समुदाय को रिपोर्ट करके शिकायतों का निपटारा किया जाएगा।

16. क्या इस अध्ययन में मेरे भाग लेने को गोपनीय रखा जाएगा?

हां, इसे गोपनीय रखा जाएगा।

17. शोध अध्ययन के परिणामों का क्या होगा?

अध्ययन के परिणामों का उपयोग ऊपरी जबड़े (मैक्सिलरी आर्च) में छोटे प्रत्यारोपण की सफलता का आकलन करने के लिए किया जाएगा। किसी भी रिपोर्ट/प्रकाशन के मामले में आपकी पहचान गोपनीय रखी जाएगी।

18. शोध का आयोजन कौन कर रहा है?

यह शोध अध्ययन शैक्षणिक संस्थान (बीबीडीसीओडीएस) द्वारा आयोजित किया जाता है।

19. क्या अध्ययन समाप्त होने के बाद अध्ययन के परिणाम उपलब्ध कराए जाएंगे?

हां। यदि रोगी चाहे तो अध्ययन का परिणाम उसे उपलब्ध कराया जाएगा।

20. अध्ययन की समीक्षा किसने की है?

अध्ययन की समीक्षा की गई है और संस्थान के विभागाध्यक्ष और आईईसी/आईआरसी द्वारा अनुमोदित किया गया है।

21. अधिक जानकारी के लिए संपर्क करें

**डॉ. जिग्मे पलजोर** डेन्जोंगपास

पीरियोडोंटोलॉजी **विभाग**

**बाबू बनारसी दास कॉलेज ऑफ डेंटल साइंसेज।**

**लखनऊ-226028**

**मोब- 6297988469**

**डॉ. वंदना ए पंत (प्रोफेसर)**

पीरियोडोंटोलॉजी **विभाग**

**बाबू बनारसी दास कॉलेज ऑफ डेंटल साइंसेज।**

**लखनऊ-226028**

**मोब-9935957775**

**डॉ. सुनील सी वर्मा (रीडर)**

**पीरियोडोंटोलॉजी विभाग**

**बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।**

लखनऊ-226028

मोब-9335928773

bbdcods.iec@gmail.com

पीआई के हस्ताक्षर .....

नाम.....

तारीख.....

## ANNEXURE -5

## FORMULA USED FOR STATISTICAL ANALYSIS

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 23.0 Version. The descriptive statistics included mean, standard deviation .The intragroup comparison for the different time intervals was done using paired t test to find the difference between the individual time intervals The level of the significance for the present study was fixed at 5%.

The intergroup comparison for the difference of mean scores between two independent groups was done using the unpaired/independent t test

The Shapiro–Wilk test was used to investigate the distribution of the data and Levene's test to explore the homogeneity of the variables. The data were found to be homogeneous and normally distributed. Mean and standard deviation (SD) were computed for each variable

**Mean**

$$\overline{X} = \frac{\Sigma X}{N}$$

Where:
$\overline{X}$ = the data set mean
$\sum$ = the sum of
$X$ = the scores in the distribution
$N$ = the number of scores in the distribution

**Range**

$$range = X_{highest} - X_{lowest}$$

Where:
$X_{highest}$ = largest score
$X_{lowest}$ = smallest score

**Variance**

$$SD^2 = \frac{\Sigma(X - \overline{X})^2}{N}$$

The simplified variance formula

$$SD^2 = \frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N}$$

Where:
$SD^2$ = the variance
$\sum$ = the sum of
$X$ = the obtained score

$\overline{X}$ = the mean score of the data
$N$ = the number of scores

**Standard Deviation (N)**

$$SD = \sqrt{\frac{\Sigma(X - \overline{X})^2}{N}}$$

The simplified standard deviation formula

$$SD = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N}}$$

Where:
SD = the standard deviation
$\sum$ = the sum of
$X$ = the obtained score
$\overline{X}$ = the mean score of the data
$N$ = the number of scores

**Paired t test**

$$t = \frac{\overline{x} - 0}{SE(d)} = \frac{\overline{x}}{SD(x)/\sqrt{n}}$$

A paired t-test is used to compare two population means where you have two samples in which observations in one sample can be paired with observations in the other sample. Examples of where this might occur are: - Before-and-after observations on the same subjects (e.g. students' diagnostic test results before and after a particular module or course) or A comparison of two different methods of measurement or two different treatments where the measurements/treatments are

applied to the same.

**Independent t-test**

Independent t Test can be used to determine if two sets of data are significantly different from each other, and is most commonly applied when the test statistic would follow a normal distribution. The independent samples *t*-test is used when two separate sets of independent and identically distributed samples are obtained, one from each of the two populations being compared

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\left(\frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

Where X1 =Mean of the first Group, X2 =Mean of the Second Group.

## ANNEXURE - 6

### Comparison of parameters at follow up periods

| PARAMETERS | PAIRS | SHORT | | CONVENTIONAL | |
|---|---|---|---|---|---|
| | | Mean difference | P value | Mean difference | P value |
| Marginal Bone Loss | 3 months vs 6 months | 0.01 | 0.867, NS | 0.02 | 0.867, NS |
| Plaque Index | 3 months vs 6 months | 0.02 | 0.652, NS | 0.21 | **0.001***, S |
| Sulcus Bleeding Index | 3 months vs 6 months | 0.10 | 0.525, NS | 0.50 | **0.001***, S |
| Probing Pocket Depth | 3 months vs 6 months | 0.25 | 0.089, NS | 0.17 | 0.155, NS |

### Short Versus Conventional Implants

| PARAMETER | FOLLOW UP PERIOD | IMPLANT | Mean | Std. Deviation | Mean difference | P value |
|---|---|---|---|---|---|---|
| Marginal Bone Loss | 3 months | Short | 0.31 | 0.08 | 0.01 | 0.612, NS |
| | | Conventional | 0.32 | 0.15 | | |
| | 6 months | Short | 0.32 | 0.10 | 0.02 | 0612, NS |
| | | Conventional | 0.30 | 0.13 | | |
| Plaque Index | 3 months | Short | 0.50 | 0.52 | 0.06 | 0.234, NS |
| | | Conventional | 0.56 | 0.16 | | |
| | 6 months | Short | 0.52 | 0.51 | 0.17 | 0.153, NS |
| | | Conventional | 0.35 | 0.11 | | |
| Bleeding Index | 3 months | Short | 0.60 | 0.51 | 0.20 | 0.178, NS |
| | | Conventional | 0.80 | 0.42 | | |
| | 6 months | Short | 0.50 | 0.52 | 0.20 | 0.178, NS |
| | | Conventional | 0.30 | 0.48 | | |
| Probing Pocket Depth | 3 months | Short | 2.68 | .57 | 2.32 | **0.001***, NS |
| | | Conventional | 5.00 | .35 | | |
| | 6 months | Short | 2.93 | .55 | 1.90 | **0.001***, NS |
| | | Conventional | 4.83 | .39 | | |

## MASTER CHART

| PATIENT | MARGINAL BONE LEVEL(mm) | MODIFIED PLAQUE INDEX | MODIFIED GINGIVAL INDEX | PROBING POCKET DEPTH(mm) |
|---|---|---|---|---|
| 1)BASELINE | 2.6 | NA | NA | 2.6 |
| AT 3 MONTHS | 2.9 | 1 | 1 | 3.1 |
| AT 6 MONTHS | 3.0 | 0 | 1 | 3.3 |
| 2)BASELINE | 2.0 | NA | NA | 1.8 |
| AT 3 MONTHS | 2.3 | 1 | 1 | 2.3 |
| AT 6 MONTHS | 2.5 | 1 | 0 | 2.7 |
| 3)BASELINE | 1.8 | NA | NA | 1.3 |
| AT 3 MONTHS | 2.0 | 0 | 1 | 1.7 |
| AT 6 MONTHS | 2.1 | 1 | 1 | 1.9 |
| 4)BASELINE | 1.9 | NA | NA | 1.9 |
| AT 3 MONTHS | 2.2 | 0 | 0 | 2.3 |
| AT 6 MONTHS | 2.4 | 0 | 0 | 2.6 |
| 5)BASELINE | 2.2 | NA | NA | 1.7 |
| AT 3 MONTHS | 2.6 | 1 | 1 | 2.4 |
| AT 6 MONTHS | 2.8 | 1 | 1 | 2.8 |
| 6)BASELINE | 2.5 | NA | NA | 2.5 |
| AT 3 MONTHS | 2.8 | 0 | 0 | 3.0 |
| AT 6 MONTHS | 2.1 | 1 | 0 | 3.2 |
| 7)BASELINE | 2.0 | NA | NA | 3.0 |
| AT 3 MONTHS | 2.3 | 0 | 1 | 3.5 |
| AT 6 MONTHS | 2.4 | 1 | 1 | 3.8 |
| 8)BASELINE | 1.9 | NA | NA | 1.9 |
| AT 3 MONTHS | 2.1 | 0 | 1 | 2.5 |
| AT 6 MONTHS | 2.2 | 1 | 1 | 2.8 |
| 9)BASELINE | 2.3 | NA | NA | 2.8 |
| AT 3 MONTHS | 2.8 | 1 | 0 | 3.5 |
| AT 6 MONTHS | 2.5 | 0 | 0 | 3.6 |
| 10)BASELINE | 2.0 | NA | NA | 2.0 |
| AT 3 MONTHS | 2.3 | 1 | 1 | 2.5 |
| AT 6 MONTHS | 2.4 | 0 | 1 | 2.6 |

*NA = Not Applicable

# PLAGIRISM REPORT

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## Document Information

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| **Similarity** | 8% |
| **Analysis address** | maniona2.bbduni@analysis.urkund.com |