ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS - A CBCT STUDY

A Dissertation submitted in

Partialfulfillment of the requirements

for the degree of

MASTER OF DENTAL SURGERY

BRANCH – II

PERIODONTOLOGY

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI – 600032

2017– 2020

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled **"ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS - A CBCT STUDY"** is a bonafide and genuine research work carried out by me under the guidance of **Dr.C.S.PRABHAHAR, M.D.S., Professor, Head of the Department,** Department Of Periodontology, Best Dental Science College, Madurai – 625104.

Dr.R.P.GOMATHI

CERTIFICATE BY GUIDE

This is to Certify that **Dr.R.P.GOMATHI,** Post Graduate student(2017 – 2020) in the Department Of Periodontology, Best Dental Science College, Madurai–625104 has done this dissertation titled **"ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS - A CBCT STUDY"** under my direct guidance and supervision in partial fulfilment of the regulations laid down by the Tamil Nadu Dr.M.G.R Medical University Chennai – 600032, for M.D.S. Department Of Periodontology (Branch II) Degree Examination.

Dr. C.S.PRABHAHAR, M.D.S

Professor & Guide

Head of the Department

Department of Periodontology

Best Dental Science College

Madurai – 625104.

ENDORSEMENT BY HEAD OF THE DEPARTMENT/

HEAD OF THE INSTITUTION

This is to certify that the dissertation titled **"ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS - A CBCT STUDY"** is a bonafide research work done by **R.P.GOMATHI**, Post Graduate student (2017-2020) in the Department Of Periodontology under the guidance of **Dr.C.S.PRABHAHAR, M.D.S., Professor and Guide,** Department of Periodontology, Best Dental Science College, Madurai – 625104.

Dr.C.S.PRABHAHAR, M.D.S **Dr.K.S.PREM KUMAR , M.D.S**

Professor & Head of the Department **Principal**

Department Of Periodontology,

Best Dental Science College,

Madurai – 625104

AKNOWLEDGEMENT

The purpose of education is to make

Good human being with skill and expertise.

Enlightened human being can be created by teachers

Dr.A.P.J.Abdul Kalam.

Arise! Awake! And stop not until the goal is reached.

Take risk in your life

If you win, you can lead

If you lose, you can guide.

Swami Vivekananda

Writing this thesis has been fascinating and extremely rewarding and I take this opportunity to thank everyone who helped me to complete this work and shape my future.

I would like to take this opportunity to express my deep sense of gratitude to our beloved principal Dr.K.S.PREM KUMAR,M.D.S., Professor and Head of Department of ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS, Best dental science college, Madurai., for his constant encouragement and moral support, without whom I would have never been able to give in my best.

I would like to extend my gratitude to Dr.C.S.PRABHAHAR,M.D.S.,Professor and Head of the department of PERIODONTOLOGY &ORAL IMPLANTOLOGY, who was with me in all clinical cases I do and clarifying all doubts regarding the clinical cases and research part with all his support .

Project is like a bridge between theoretical and practical working, I am feeling obliged in taking this opportunity to sincerely thank my worthy teacher Dr.V.K.VIJAY, M.D.S., MBA.(HM)., Professor who was hand in hand with me in my dissertation work & enlightened me in the right direction whenever I needed it.

I owe my special thanks to Dr.M.NARENDRA REDDY, M.D.S., Professor, for his continuous support and inspiration throughout my study.

I have no valuable words to express my thanks, but my heart is full of the favours and helps received by valuable Dr.M.NAVARASU,M.D.S., Reader, I am always grateful to his valuable contributions for guiding in each and every step I do with care .

I expressed my deep sense of gratitude to Dr.M.UMAYAL,M.D.S., Senior Lecturer, whose valuable guidance and kind supervision given to me throughout the course has shaped the present work as it shows.

It is with immense gratitude, that I acknowledge the support and help from the Chairman PROF.K.R.ARUMUGAM,M.PHARM., and Vice chairman PROF.A.R.BABUDHANDAPANI,M.PHARM,PHD., for providing me the facilities to carry out my work.

I thank the Administrative Officer Mr.G.Babu, Librarian, and department non teaching staffs Mrs.M.Nani Ayammaal and Mrs.S.Sharmila who helped me during my thesis work.

I extend my sincere thanks to Mithra Scans for providing me with the CBCT on time & their valuable support. I am grateful to Dr.A.Deepta Ramarao for helping me with the statistical analysis of the study.

In the world full of competition, I am always thankful to my Co-PG DR.B.KARTHIGA who is a sister from another mother, constantly supporting me and providing a stress free environment to complete my dissertation work.

I would like to thank my seniors Dr.T.Suganya Harshni and Dr.V.Benedict and my juniors Dr.M.S.Mugil, Dr.M.Tamilarasan, Dr.P.Rajesh Kamatchi and Dr.C.Tintu for their moral support and encouragement.

My special thanks to my super seniors Dr.R.Nivetha , and Dr.K.B.R.Ramya Kumari from the bottom of my heart.

I share the credit of my work with Dr.A.Tamilarasan, Mrs.S.Sudha, Miss.S.Pandimuneeswari, Mr.G.Muruganantham& Mr.U.Muneeswaran.

Nothing could be achieved without the support of my family members – my husband Dr.A.Bamaselvakumar M.D.S, for constantly encouraging me, my sons B.Sivshraven, B.Kriskarthik, my dad Mr.R.Ramalingam, my mom Mrs.R.Parvathy, my in laws Mr.M.Ayyanar, Mrs.K.Arumugam, my sister Dr.R.P.Mahalakshmi M.S, my brother in law Dr.K.Velmurugan M.S, Dr.A.Sugabharanitharan, M.D, my co-sister Dr.M.Priya, my sister in law Mrs.A.Puthalesli, my brother Er.Govindharaj, my daughters V.Dharshitha, V.Kaavya, G.Hashumathilakshmi & S.Nigazhini. I thank them for their moral support and encouragement.

Last but not the least, I thank THE ALMIGHTY LORD OM MURUGAN THUNAI AND LORD OM SAI RAM who is Omni-potent and Omni-present.

Dr.R.P.GOMATHI

DATE: 1st JAN 2020

PLACE: MADURAI

CERTIFICATE II

This is to certify that this dissertation work titled "**ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS - A CBCT STUDY"** the candidate **Dr.R.P.GOMATHI** with registration Number **241713401** for the award of **Masters of Dental Surgery** in the branch of Periodontology. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 5 percentage of plagiarism in the dissertation.

Guide & Supervisor sign with Seal.

URKUND

Urkund Analysis Result

Analysed Document: R.P.GOMATHI.doc (D61369580)
Submitted: 12/18/2019 6:00:00 PM
Submitted By: gomsbama@gmail.com
Significance: 5 %

Sources included in the report:

https://pocketdentistry.com/2-osseointegration/
https://www.magiran.com/paper/877488/?lang=en
https://www.researchgate.net/publication/51116427_The_role_of_bone_debris_in_early_healing_adjacent_to_hydrophilic_and_hydrophobic_implant_surfaces_in_man
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6104555/
https://www.researchgate.net/figure/mplant-Distribution-According-to-Final-Tightening-Force_tbl1_8940602
https://www.aegisdentalnetwork.com/id/special-issues/2009/08/replacement-of-a-single-missing-tooth-with-an-implant-supported-patient-specific-restoration
https://www.researchgate.net/publication/279999103_Short_Dental_Implants_Its_Rationale_for_Use
https://www.researchgate.net/profile/Shammas_Mohammed5/publication/279999103_Short_Dental_Implants_Its_Rationale_for_Use/links/5ca99c6aa6fdcca26d045ba9/Short-Dental-Implants-Its-Rationale-for-Use.pdf
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3357042/

Instances where selected sources appear:

12

DECLARATION

TITLE OF DISSERTATION	**"ASSESSMENT OF PERI IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS-A CBCT STUDY"**
PLACE OF STUDY	**BEST DENTAL SCIENCE COLLEGE, MADURAI – 625104**.
DURATION OF THE COURSE	**3 YEARS**
NAME OF THE GUIDE	**Dr. C.S.PRABHAHAR, M.D.S**
HEAD OF THE DEPARTMENT	**Dr. C.S.PRABHAHAR, M.D.S**

I hereby declare that no part of the dissertation will be utilized for gaining financial assistance/any promotion without obtaining prior permission of the Principal, Best Dental Science College, Madurai – 625104. In addition, I declare that no part of this work will be published either in print or in electronic media without the guide who has been actively involved in dissertation. The author has the right to reserve for publication of work solely with the prior permission of the Principal, Best Dental Science College, Madurai – 625104.

HOD **GUIDE** **Signature of the candidate**

COPYRIGHT

DECLARATION BY THE CANDIDATE

I hereby declare that The Tamil Nadu Dr. M.G.R Medical University, Tamil Nadu shall have the rights to preserve, use and disseminate this research in print or electronic format for academic / research purpose.

Date: **Signature of the Candidate**

Place: MADURAI **DR.R.P.GOMATHI**

TRIPARTITE AGREEMENT

This agreement herein after the "Agreement" is entered into on this day 1st Jan 2020, between the Best Dental Science College represented by its **Principal** having address at Best Dental Science College, Madurai – 625104, (hereafter referred to as, 'The College')

And

Mr.Dr.C.S. PRABHAHAR, M.D.S., aged 45 years working as **Professor and HOD** in Department of Periodontology at the College, having residence address at 9/3 Vallalar Street, Alagappapuram, Karaikudi – 630 002, Sivagangai district.

(herein after referred to as the 'Principal Investigator')

And

Mrs.Dr.R.P.GOMATHI aged 36 years currently studying as **Post Graduate student** in Department of Periodontology, Best Dental Science College, Madurai- 625104 (herein after referred to as the 'PG/Research student and co-investigator')

Whereas the PG/Research student as part of his curriculum undertakes to research on "ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS - A CBCT STUDY" for which purpose PG/Principal Investigator shall act as Principal Investigator and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator.

Whereas the parties, by this agreement have mutually agreed to the various issues including in particular the copyright and confidentiality issues that arise in this regard.

Now this agreement witnessed as follows

1. The parties agree that all the Research material and ownership therein shall become the vested right of the college, including in particular all the copyright in the literature including the study, research and all other related papers.
2. To the extent that the college has legal right to do so, shall grant to license or assign the copyright so vested with it for medical and/or commercial usage of interested persons/entities subject to a reasonable terms/conditions including royalty as deemed by the College.
3. The royalty so received by the college shall be shared equally by all the parties.
4. The PG Student and Principal Investigator shall under no circumstances deal with the copyright, Confidential information and know – how generated during the course of research / study in any manner whatsoever, while shall sole vest with the college.
5. All expenses pertaining to the research shall be decided upon by the Principal Investigator/Co-investigator or borne solely by the PG/Research Student, (co-investigator).
6. The college shall provide all infrastructure and access facilities within and in other institutes to the extent possible. This includes patient

interactions,introductory letters, recommendation letters and such other acts required in this regard.

7. The Principal Investigator shall suitably guide the Student Research right from selection of the Research Topic and Area till its completion. However the selection and conduct of research, topic and area of research by the student researcher under guidance from the Principal Investigator shall be subject to the prior approval, recommendations and comments of the Ethical Committee of the College constituted for this purpose.
8. It is agreed that as regards other aspect not covered under this agreement, but which pertain to the research undertaken by the PG student, under guidance from the Principal Investigator, the decision of the college shall be binding and final.
9. If any dispute arises as to the matters related or connected to this agreement herein, it shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act1996.

   In witness whereof the parties hereinabove mentioned have on this day, month and year herein above mentioned set their hands to this agreement in the presence of the following two witnesses.

College represented by its **Principal**

PG Student

Witnesses **Student guide**

1.

2.

ABSTRACT

BACKGROUND AND OBJECTIVES

The purpose of this study is to clinically assess and compare the peri-implant marginal bone level in single crowns supported by short dental implants for a period of 1 year at regular 3 months time interval.

MATERIALS AND METHODS:

14 subjects in age range of 18-55 years, with at least one missing maxillary/ mandibular posterior tooth were selected and received 14 short dental implants. Clinical parameters namely the modified plaque index, gingival index, probing depth, implant mobility scale were recorded. The radiographic parameter, bone loss was measured at 4 sites namely mesial horizontal, mesial vertical, distal horizontal, distal vertical by using CBCT. All the parameters were recorded before and after implant placement and at 3 months interval till one year. CBCT analysis will be done at baseline, 3 months (the time of crown placement), 9 months (after crown placement) to assess the peri-implant marginal bone level changes around implants.

RESULTS:

The mean bone loss at the mesial horizontal site was 1.86 ± 0.32 mm, mesial vertical site was 1.73 ± 0.34 mm, distal horizontal site was 1.09 ± 0.45 mm, and distal vertical site was 0.81 ± 0.38 mm at 3 months. The mean bone loss at the mesial horizontal site was 1.81 ± 0.19 mm, mesial vertical site was 1.69 ± 0.27 mm, distal horizontal site was 1.06 ± 0.33 mm, and distal vertical site was 0.76 ± 0.29 mm at 12 months. The comparison of bone loss between 3 and 12 months at various sites (mesial horizontal, mesial vertical, distal horizontal,

distal vertical) was done. The results showed significant differences ($p \leq 0.05$) for modified plaque index, gingival index, probing depth. The overall mean bone loss at 3 months was found to be 1.37 ± 0.57 mm. The overall mean bone loss at 12 months was found to be 1.33 ± 0.51 mm. The comparison of the overall mean bone loss at 3 months and 12 months was 1.37 ± 0.57 mm and 1.33 ± 0.51 mm respectively.

Conclusion:

With the limitation of the study, it was concluded that the characteristics of the implant surface may influence the survival rate of short dental implants with minimal peri-implant marginal bone loss.

Key words:

Short dental implants, Peri-implant marginal bone level, SLA surface, CBCT.

LIST OF ABBREVIATIONS USED

ABBREVIATIONS	DESCRIPTIONS
SHIs	Short Implants
SLA	Sand blasted Large grit acid etched
AE	Acid Etched Surface
IAJ	Implant Abutment Junction
Ti-6AL-4V	Titanium Alloy
3D	Three Dimensional
CBCT	Cone Beam Computed Tomography
MBL	Marginal Bone Level
DBL	Distal Bone Level
UNC-12	University Of North Carolina-12
MPI	Modified Plaque Index
GI	Gingival Index
PPD	Probing Pocket Depth
BBL	Buccal Bone Level
LBL	Lingual Bone Level
CT Scan	Computed Tomography Scan
HB	Heamoglobin

ABBREVIATIONS	DESCRIPTIONS
Ncm	Newton CentiMeter
GG	Sinus grafting
OHIP	Oral Health Implant Profile
PS	Platform Switched implants
PM	Platform Matching abutment
TLSI	Tissue Level Short Implants
BLSI	Bone Level Short Implants
BLPDSI	Bone Level and Plateau design
SR	Survival Rate
RCT	Randomised Controlled Trials
RR	Relative Risk
IP	Implant Placement
CSR	Cumulative Survival Rate
SD	Standard deviation
IS	Implant Survival
ISQ	Implant Stability Quotient
ANSYS	Analysis System

ABBREVIATIONS	DESCRIPTIONS
FEA	Finite Element Analysis
FP	Fixed Prosthesis
BOP	Bleeding On Probing
Di	Bone level on implant side
Dt	Bone level on tooth side
IOPA	Intra Oral Periapical Radiograph
RVG	Radio Visio Graphy
HSDM	Harward School of Dental Medicine
HU	Hounsfield Units
D	Bone Density

LIST OF TABLES

LIST OF GRAPHS

LIST OF FIGURES

LIST OF CONTENT

INTRODUCTION

The goal of modern dentistry is to provide a healthy and beautiful smile that is supported by a functional and comfortable occlusion and to prevent tooth loss. However, there are situations in which extraction is the only course of treatment. In the posterior region, tooth loss is very embarrassing to the patient as it affects the aesthetics, speech and function.

After tooth extraction, bone loss remains an important issue in dentistry. Anatomically, bone resorption occurs both buccolingually and apicocoronally and the first 6 months post extraction are critical, carrying the highest rate of bone resorption in either direction. The clinical, anatomic and radiologic characteristics of the socket immediately after tooth extraction are distinctly different from the socket environment after 1 year of healing.

Several options are available for the replacement of a single missing tooth. A removable partial denture is one option for the replacement of a missing tooth. Most of the patients are not satisfied with this due to the bulk of metal or acrylic and the unsightly clasps necessary to stabilize the prosthesis. It has been shown that poorly fitting partial and complete dentures lead to bone resorption as only 10% of the chewing efficacy is achieved by these, causing gradual bone loss[1]. Dentists put forth substantial clinical skills in an attempt to manage with the consequences of partial or complete edentulism[2, 3]. Unfortunately under the conventional partial or complete dentures, the residual alveolar ridge resorption is unavoidable[4].

Today, the two most common treatment options for single tooth replacement are the fixed partial denture and the ***implant supported prosthesis.***

Dental implant appeared as an alternative option after the accidental observation of integration of titanium screws into bone was observed by **Bothe et al** in 1940 and later

described by **Gottlieb Leventhal** in 1951. The use of osseointegrated endosseous implant to support the fixed or removable prosthetic treatment has residual alveolar bone preservation[4].

The reactions have been described by **Leventhal and Bothe et al,** were later coined into the term "osseointegration" by **Per-Ingvar Branemark**[5]. Osseointegration is known as direct bone anchorage to an implant body, which provides support for prosthesis and it allows the transmission of occlusal forces directly to the bone[6, 7].

Implant could be a biocompatible alloplastic material or device that is surgically placed into orofacial tissues and used for anchorage, functional, therapeutic, and/or esthetic purposes[8].

Dental implant therapy has provided us with one of the fore most promising tooth replacement procedures. Over previous few decades, there has been an increasing use of endosseous (in-bone) implants as methods of providing a support for intra-oral prosthetic devices, from full arch dentures to single crowns or different devices for orthodontic anchorage or distraction osteogenesis.

Implant dentistry is the field of dentistry involved with the diagnosis, design, and insertion of implant devices and implant restorations that provide adequate function, comfort, and aesthetics for the edentulous and/or partially edentulous patients [9, 10].

Primary implant stability[11] plays main role in the success of implants which depends on biocompatibility of the implant material, macroscopic and microscopic nature of the implant surface, the status of the implant bed in both a health and a morphologic context, the surgical technique, the health of the person receiving the treatment, gender, occlusion and the health of the tissues in the mouth, jaw type the subsequent prosthetic design and long-term loading phase[2, 6, 8, 12, 13]. Length and diameter of the implant and quantity and quality of bone are also found to play an important role in the success of implant therapy[14].

Replacement of a single missing tooth with an implant supported prosthesis is a conservative approach than preparing two adjacent teeth for a tooth supported fixed prosthesis[7].Since the introduction of dental implants for the replacement of missing teeth, various modifications in implant designs & surgical techniques have been evolved to improve the treatment outcome of the implant supported prosthesis. Bone remodelling occurs during the first year in response to occlusal forces and establishment of normal dimensions of the peri- implant soft tissues. Thus an implant with marked bone loss may be judged as surviving rather than successful[15, 16].

Over the years, various strategies have been proposed to overcome the dimensional limitations of the bone available for implant placement. Several surgical interventions for bone augmentation have been proposed, including bone grafts, guided bone regeneration, distraction osteogenesis, sinus floor elevation, mandibular nerve transposition, and the use of tilted or zygomatic implants. Although these techniques have gained a degree of success through the years, with the exception of sinus floor elevation, there are insufficient data on their predictability. Short implants (SHIs) have been proposed as an alternative choice for the prosthetic treatment of atrophic alveolar ridges, which may provide surgical advantages including reducing morbidity, treatment time, and costs[17].

However, longer implants have always been considered more reliable due to both an improved crown-to-implant ratio and a greater surface area available for osseointegration, which dissipates the imposed occlusal forces. The introduction in the last decade of modified implant designs and micro structured implant surfaces that augment the integratable surface area could help to compensate for the adverse effects of decreasing the implant length, so as to maintain the extent of the bone-implant interface [17]. The biomechanical rationale behind the use of SHIs is that the crestal portion of the implant body is the most involved in load-bearing, whereas very little stress is transferred to the apical portion [17] and the increase of

implant length from 7 to 10 mm did not significantly improve its anchorage [17]. Therefore, implant length may not be a primary factor in distributing prosthetic loads to the bone-implant interface. However, the poor bone density of the atrophic jawbone, the posterior location in the mouth, and the augmented crown height of the restorations represent important risk factors in the use of SHIs that might jeopardize their survival.

The implant in this study used had a sandblasted large grit acid-etched surface (SLA), which may contribute to better osseous integration. The formation of rapid contact between bone and implant was greater in the SLA active surface compared with SLA surface.

Crestal bone loss has been documented as one of the important factors that affect the long term prognosis of an implant and its success. The use of a smaller diameter abutment on a larger diameter implant collar is believed to shift the Implant Abutment Junction (IAJ) horizontally inward. This phenomenon is called platform switching [18, 19].

Following the huge success rate of dental implants many Implant systems have been introduced into the market .One among them is the SuperLine Dentium implant system that is designed by original intent to meet the variable bio mechanical strength requirements of the different bone densities within the oral environment. All SuperLine Dentium implants and prosthetic components are made from Titanium alloy (Ti-6AL-4V) for maximum strength and biocompatibility.

The accuracy of three-dimensional (3D) cone beam CT (CBCT) in visualizing Peri-implant bone. 3D CBCT provides useful information about bone in all dimensions around implants with varying accuracy .The introduction of CBCT in 1998; indications for this imaging method include implant site assessment, temporomandibular joint examination, and visualization of periodontal osseous situation and identification of periodontal ligament spaces. CBCT perform similar in assessing MBL and DBL, but, within its limits, the CBCT

can assess oral and buccal bone. Compared with CT, radiation exposure to the patient is generally lower in CBCT. Traditional dental imaging techniques provide diagnosis related to implant planning only partially. The marginal bone on the buccal and the lingual/palatal surface of implant, the proximity of the implant to the buccal and lingual/palatal plates and possible perforation of the plates cannot be assessed with periapical radiographs. Though CT provides the same with accuracy, the radiation exposure to the patient is comparatively high. The drawbacks of these modalities were improved with the introduction of Cone Beam Computed Tomography (CBCT) for imaging orofacial structures. Upon acquiring the image, CBCT manufacturers use advanced mathematical algorithms so that as the data are projected in screen they are already corrected for magnification. The measurements provided are very precise for most CBCT scanners in the market[20, 21& 22]. This technique uses isotopic voxels of a size down to 0.08mm; additionally metallic artefacts are less severe in CBCT than in CT[23].

AIM AND OBJECTIVES

AIM:

The aim of this present study is to assess and compare the peri-implant marginal bone level in single crowns supported by short dental implants.

OBJECTIVES:

- To compare the modified plaque index, gingival index at baseline, 3, 6, 9 and 12 months after implant placement.
- To compare the probing depth around implants using UNC-12 plastic probe and the implant mobility scale 3 months, 6 months, 9 months and 12 months.
- To compare the peri-implant marginal bone level changes around dental implants using CBCT analysis at 3 months (at the time of crown placement), and 9 months (after crown placement).

GENERAL REVIEW

Egyptians, who placed hammer shaped seashells directly into the jaws for the purpose of replacing missing teeth [24].Over the last few centuries a variety of materials have been implanted into the jaws in an attempt replace missing teeth. The success of these early implants was extremely poor, because they never achieved a stable state of integration with the supporting tissue [25].

The history of modern implant dentistry began with the introduction of titanium implants. In the 1950s Per Ingvar Branemark had a serendipitous finding while studying in blood circulation in bone. In 1952, **Per-Ingvar Branemark [26]** of Sweden conducted an experiment where he utilized a titanium implant chamber to study the blood flow in rabbit bone. He discovered an intimate bone-to-implant apposition with titanium that offered sufficient strength to cope with load transfer. He called the phenomenon "Osseointegration" and developed an implant system with a specific protocol to predictably achieve it. The implant were used to anchor prosthetic replacement teeth in edentulous jaw[39]and the first patient was successfully treated in 1965 [27,28].

The osseointegration depends on some factors such as its surface characteristics, its design, coating of the surface, technique of placement, laser treatment of implant surface, bone source to augment the socket to have a proper primary stability.

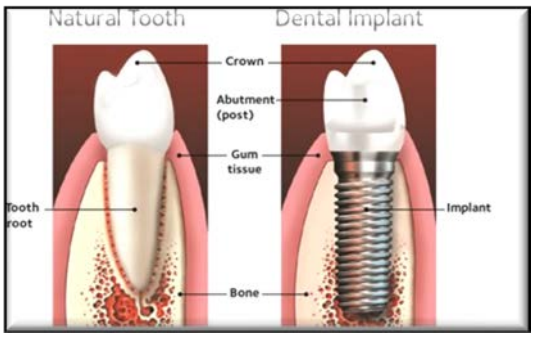


Fig 1 : Natural tooth Vs Dental implant

There are 3 basic types of dental implants

Endosseous implants

Subperiosteal frame like implants

Transmandibular implants

CLASSIFICATION OF IMPLANTS:

Dental implants may be classified under four categories

A - Depending on the placement within the tissues

B - Depending on the materials used

C - Depending on their reaction with bone

D - Depending on the treatment options

A - DEPENDING ON THE PLACEMENT WITHIN THE TISSUES:

Depending on the placement within the tissues, implants can be classified into-

ENDOSSEOUS:

- Root form
- Blade(plate) form
- Ramus frame

SUBPERIOSTEAL:

- Unilateral
- Complete
- Circumferential

TRANSOSTEAL:

- Staple
- Single Pin
- Multiple Pin

B - DEPENDING ON THE MATERIALS USED:

Based on the materials used, the implants can be classified into -

METALLIC IMPLANTS:

- Titanium
- Titanium alloy
- Cobalt Chromium Molybdenum alloy

NON- METALLIC IMPLANTS:

- Ceramic
- Carbon

C - DEPENDING ON THEIR REACTION WITH BONE:

Based on the ability of the implant to stimulate bone formation, implants can be classified into

- Bioactive implants - Hydroxyapatite
- Bio-inert implants – metals

D - DEPENDING ON THE TREATMENT OPTIONS:

Misch in 1989 reported five prosthetic options of implants. The first three are fixed prosthesis that may be partial or complete replacements, which in turn may be cemented or screw retained. The fixed prosthesis are classified based on the amount of hard and soft tissue structures that are to be replaced.

The remaining two are removable prosthesis that is classified based on the support derived.

- **FP- I:** Fixed prosthesis; replaces only the crown; looks like a natural tooth.
- **FP- 2:** Fixed prosthesis; replaces the crown and a portion of the root; crown contour appears normal in the occlusal half but is elongated or hyper contoured in the gingival half.
- **FP- 3:** Fixed prosthesis; replaces missing crowns and gingival colour and portion of the

edentulous site; prosthesis most often uses denture teeth and acrylic gingival, but may be made of porcelain or metal.

- **RP-4:** Removable prosthesis; overdenture supported completely by implant.
- **RP-5:** Removable prosthesis; overdenture supported by both soft tissue and implant (69).

The available bone and its densities have influence on implant success rate Linkow, in 1970, classified bone density into three categories:

- **Class I bone structure:** This ideal bone type consists of evenly spaced trabeculae with small cancellated spaces.
- **Class II bone structure:** The bone has slightly larger cancellated spaces with less uniformity of the osseous pattern.
- **Class III bone structure:** Large, marrow-filled spaces exist between bone trabeculae.

Linkow explained that class I bone was the most ideal and class II bone is satisfactory for implant prostheses In 1985, Lekholm and Zarb discussed four bone qualities found in the anterior regions of the jaw bone.

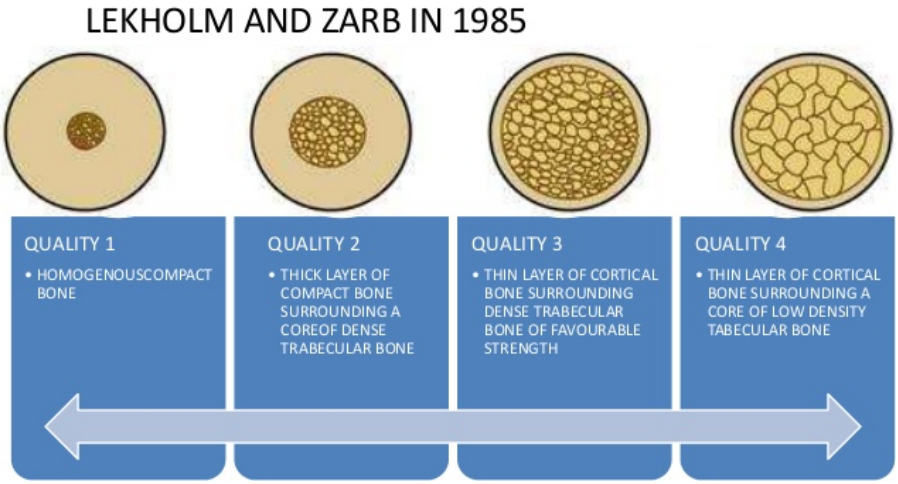


Fig 2 : Lekholm and Zarb Classification

MISCH BONE DENSITY CLASSIFICATION:1988

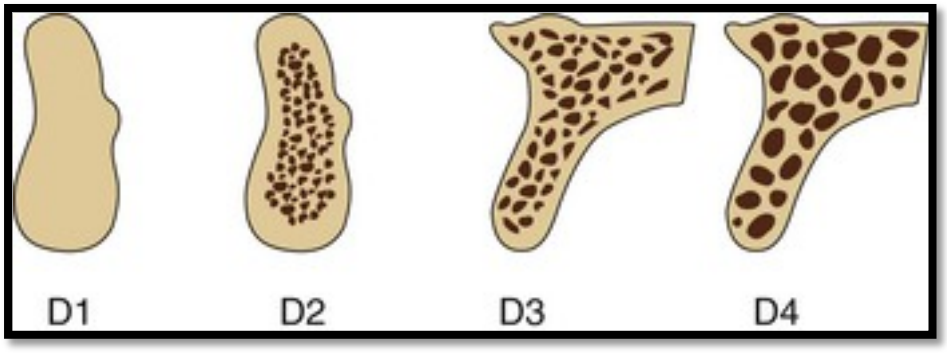


Fig 3: Misch Bone Density Classification

Misch described four bone densities found in the anterior and posterior edentulous regions of the maxilla and mandible.

- **D1** bone is primarily dense cortical bone
- **D2** bone has dense to thick porous cortical bone on the crest and coarse trabecular bone underneath
- **D3** bone has a thinner porous cortical crest and fine trabecular bone within
- **D4** bone has almost no crestal cortical bone

Bone density can be determined by tomographic radiographs, especially CT (computer tomography). Each CT axial image has 260,000 pixels, and each pixel has a CT number (Hounsfield unit) related to the density of the tissues within the pixel. In general, the higher the CT number, the denser the tissue.

- **D1**: > 1250 Hounsfield units
- **D2**: 850-1250 Hounsfield units
- **D3**: 350--850 Hounsfield units
- **D4**: 150--350 Hounsfield unit
- **D5**: <150 Hounsfield units (Misch)

REVIEW OF LITERATURE

Ahmed A et al 2009 [29] studied a retrospective chart review of patients at the HSDM who had one or more short dental implant placed and restored. Certain inclusion and exclusion criteria were chosen to screen the charts. Demographic, health, and implant data were collected and analyzed by multimodel analyses to determine failure rates and any factors that may have increased the likelihood of an implant failure. A retrospective chart review of patients at the HSDM who had one or more short dental implant placed and restored was performed. Certain inclusion and exclusion criteria were chosen to screen the charts. Demographic, health, and implant data were collected and analyzed by multimodel analyses to determine failure rates and any factors that may have increased the likelihood of an implant failure. This study confirms previously identified risk factors for a failure. Short dental implants seem to be a viable option for replacing missing teeth in strictly controlled conditions, including conditions related to the oral environment and the overall health of subjects. The periodontist and restorative dentist need to analyze all related factors during planning the treatment and selecting appropriate implant dimensions and design.

Pommer B et al 2011[30] tested there is no difference in failure rates of short (minimum length: 7mm) and longer dental implants (X10mm), a meta-analysis was performed on prospective observational trials. A systematic electronic and hand search was performed to identify eligible studies. Having additional data supplied by the authors, 54 publications were included (19,083 implants). In areas of reduced alveolar bone height, the use of short dental implants may reduce the need for invasive bone augmentation procedures.

Telleman G et al 2012[31] assessed the outcome of short implants (8.5 mm) supplied with a conventional platform-matched implant-abutment connection or a platform-switched design. Eighty patients with one or more missing teeth in the posterior zone were randomly assigned

to be treated with implants with either a conventional (control) or a platform-switched (mismatch 0.35–0.40 mm) implant abutment connection (test). Follow-up visits were conducted 1 month and 1 year after placing the implant crown. Outcome measures were inter-proximal bone loss, using standardized peri-apical radiographs, implant survival, clinical parameters and patient's satisfaction. This study suggested that crestal bone resorption may be reduced by platform switching. One year after loading, inter-proximal bone levels were better maintained at implants restored according to the platform switching concept.

Annibali A et al 2012[32] systematically evaluated the clinical studies of implants < 10 mm in length, to determine short implant-supported prosthesis success in the atrophic jaw. Implant survival, incidence of biological and biomechanical complications, and radiographic peri implant marginal bone loss were evaluated. Screening of eligible studies, quality assessment, and data extraction were conducted by two reviewers independently. Meta-analyses were performed by the pooling of survival data by implant surface, surgical technique, implant location, type of edentulism, and prosthetic restoration. Two randomized controlled trials and 14 observational studies were selected and analyzed for data extraction. In total, 6193 short-implants were investigated from 3848 participants. The observational period was 3.2 ± 1.7 yrs (mean ± SD). The cumulative survival rate (CSR) was 99.1% (95%CI: 98.8-99.4). The biological success rate was 98.8% (95%CI: 97.899.8), and the biomechanical success rate was 99.9% (95%CI: 99.4-100.0). A higher CSR was reported for rough surfaced implants. The provision of short implant supported prostheses in patients with atrophic alveolar ridges appears to be a successful treatment option in the short term; however, more scientific evidence is needed for the long term.

Monje A et al 2013[33] proved in meta-analysis of prospective clinical trials was conducted to determine the effects of dental implant length and width on implant survival rate of short

(<10 mm) implants. Selected studies were randomized clinical trials, human clinical trials, or prospective trials with a clear aim of investigating the success or survival rate of short (<10 mm) implants. Neither implant length nor width seemed to significantly affect the survival rate of short implants (<10 mm). Nonetheless, further well-designed randomized clinical trials are needed to confirm these findings.

Lai HC et al 2013[34] evaluated the clinical and radiographic data of 231 short implants (intra-bony length 8 mm) supporting single crowns in 168 patients, were collected after 5–10 (mean 7.22) years follow-up retrospectively. 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. One may conclude 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[35] reviewed a systematic analysis to evaluate the effect of implant length on peri-implant marginal bone loss (MBL) and its associated influencing factors. Randomized clinical trials, human experimental clinical trials or prospective studies (e.g., cohort as well as case series) were conducted with a clear aim of investigating marginal bone loss of short dental implants (<10 mm) supporting fixed prostheses. A random effect Meta regression model was used to determine the relationship between the effect sizes mean MBL and the covariate "implant length." Additionally, a subgroup analysis, by means of a random-effect one-way ANOVA model, comparing mean MBL values at different levels of each factor ("type of connection" and "type of prostheses") was also performed. Within limitations of the present systematic review, it could be concluded that short dental implants (<10 mm) had similar Peri-implant MBL as standard implants (≥10 mm) for implant supported fixed prostheses.

Thoma D et al 2014[36] assessed the use of short dental implants (6mm) results in an implant survival rate similar to long implants (11-15mm) in combination with sinus grafting. This multicenter study enrolled 101 patients with a posterior maxillary bone height of 5-7mm. Patients randomly received short implants (6mm) (group short) or long implants (11-15mm) with sinus grafting (group graft). Six months later, implants were loaded with single crowns and patients re-examined at one year of loading. Outcomes included: treatment time, price calculations, safety, patient-reported outcome measures (OHIP-49=Oral Health Impact Profile) and implant survival. Statistical analysis was performed using a non-parametric approach. Both treatment modalities can be considered suitable for implant therapy in the atrophied posterior maxilla. Short implants may be more favourable regarding short-term patient morbidity, treatment time and price.

Nisand D et al 2014[37] reviewed systemic analysis to evaluate the data available on the survival rate of short and extra-short implants and to discuss the impact of an increased crown to implant length ratio on biological and technical complications. Indications and clinical procedures for short-length implants in clinical practice are also reviewed, along with a discussion on the selection of the implant length. He introduced a new concept in implant dentistry: stress-minimizing surgery. There is still some controversy over the exact definition of a short-length implant. According to Striezel & Reichart, an implant of ≤11 mm is considered as short, whereas Tawil & Younan stated that an implant must be ≤10 mm to be regarded as short. In one recent systematic review and in one recent meta-analysis, all implants of <10 mm were defined as short implants. For the purposes of this review, a short implant will be defined as an implant with a designed intrabony length of ≤8 mm and an extra-short implant as a device with a designed intrabony length of ≤5 mm.

Rossi F et al 2014[38] **e**valuated prospectively the clinical and radiographic outcomes after 5 years of early loading of 6-mm implants with a moderately rough (SLActive) surface

supporting single crowns in the posterior regions. This study demonstrated that 6mm short implants, loaded in an early phase of the healing (between 6 and 7 weeks afterward) and supporting single crowns, were able to fully maintain function for the observation period of 5 years. The study concluded that 6mm implants with a SLA active moderately rough surface supporting single crowns in the posterior region and loaded after 6–7 weeks maintained full function for at least 5 year with low marginal bone resorption. A mean marginal bone loss of 0.7mm± 0.6mm was found after 5 years of function.

Schincaglia GP Et al 2015[39] evaluated clinically and radio graphically, short dental implants (6 mm) to long implants (11–15 mm) placed with sinus grafting in 97 subjects, 132 implants. Implants were loaded with single crowns 6 months after placement, He indicated that short implants (6 mm) provided a similar clinical and radiographic performance compared to longer implants (11–15 mm) placed in combination with a sinus augmentation procedure (lateral window). The MBL from implant placement (IP) to (PR) was -0.22± 0.4 mm for GG and -0.3± 0.45 mm for GS ($p < 0.001$). MBL from IP to FU-1 was -0.37± 0.59 mm for GG and -0.22 ± 0.3 mm for GS ($p < 0.001$). Intergroup comparisons showed non-significant differences for MBL ($p > 0.05$).

Gerado MA et al 2016[40] conducted a prospective clinical trial study including 82 systemically healthy, non-smoking subjects. Patient were divided into two groups: one group for short dental implants measuring 5.5 or 7mm,and other group for standard dental implants measuring 10mm or 12mm, in accordance with the individual needs of patient .The implants were evaluated radiograpically and cone beam computer tomography. A statistically significant difference was found in favour of standard implants after 12 months, with greater gingival recession around the implant: however, bone loss in the short implants did not exceed 0.53mm.The treatment with 5.5mm to7mm length is as reliable as a treatment with 10 or 12mm implants. The study concluded that Peri-implant bone loss is minimal, and therefore

use of short implants can be recommended as treatment for the restoration of partially edentulous patients without the need for splinted crowns.

Palacios J et al 2016[41] conducted a systematic review to compare the survival rates between short implants (length < 10 mm) versus standard-length implants (≥ 10 mm) inserted in grafted bone. As secondary outcomes, marginal bone loss and survival rates of the implant supported prostheses were also analysed. Randomised controlled trials (RCT) that compared both techniques were searched on three electronic databases till June 2016. A manual search was performed on the bibliography of the collected articles, and the authors were contacted for additional references. The estimates of the interventions were expressed in relative risk (RR), mean implant survival rates and mean differences in marginal bone. This systematic review suggests no difference between both techniques in the treatment of atrophic arches. However, more long-term RCTs are needed to evaluate the predictability at a longer run. Clinical relevance of the use of short implants might be considered as an alternative treatment, since it usually requires fewer surgical phases and tends to be a more affordable option.

Annunziata M et al 2017[42] conducted a study which includes 30 patients of edentulous lower arch for receiving a fixed prosthetic rehabilitation supported by five interforaminal implants in three Italian study centres. (Osseo Speed, dentsply Sirona Implants, Mölndal, Sweden). They were randomly assigned, at the time of surgery, to the test group (short 6 mm-long implants) or to the control group (standard 11 mm- long implants). After 3 months, implants were uncovered and a screw retained metal resin full arch prosthesis with distal cantilevers was positioned. Twelve months after loading, implant survival rate, and Peri-implant marginal bone loss were evaluated. Data were analyzed with the patient as the statistical unit and the significance (alpha) level set at 0.05. This study concluded that short implants showed to be a reliable option compared to standard length implants.

Sahrmann P et al 2017[43] evaluated the bone density changes on radiograph with comparing of implant length 6 and 10mm in a three year period. Three predefined areas were chosen on standardized X-rays in order to assess grey-scale values of the peri-implant bone: One at the tip of the apex and two at half-length on the mesial and distal sides of the implant. Radiographs at all follow-up appointments had previously been calibrated using control fields in areas of constant density. A higher degree of mineralization around short implants was recorded. Whether this finding goes along with hampered bone adaptability, and accordingly, higher failure rates of short implants must be studied further in long-term clinical trials.

Papaspyridakos P et al 2018[44] described in systematically reviewed randomized controlled clinical trials (RCTs) reporting on the 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. Short implants (≤6 mm) were found to have higher variability and lower predictability in survival rates compared to longer implants (>6 mm) after periods of 1-5 years in function. The mean survival rate was 96% (range: 86.7%-100%) for short implants, and 98% (range 95%-100%) for longer implants. Based on the quantity and quality of the evidence provided by 10 RCTs, 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.

Gurlek O et al 2018[45] evaluated the clinical results of "extra short" bone level implants and regular implants in the posterior atrophic maxilla. Twenty-six systemically healthy, non-smoker patients with at least two missing adjacent teeth in the posterior maxilla were included in the study. The patients in test group received 20 extra short implants and in the control group 30 regular bone level implants. One implant for each missing tooth was placed in both groups and the implants were uncovered at 3-month. Splinted restorations were fabricated in the test group, however regular implants were restored as single units. The length of the implants in the test group was 4.2 mm and the diameter was either 5.0 mm or

6.0 mm. The lengths and diameters of the implants in the control group varied between 8.0-11 mm and 4.5-5.0 mm respectively. Radiographic evaluations were performed at baseline and 6, 12-months after loading. Measurements were done by a digital image analysis system. Within the limits of the present study, it may be suggested that extra short implants may be regarded as a decent treatment option in prosthetic rehabilitation of the atrophic posterior maxilla if restored as splinted units.

Rocha SJ et al 2018[46] conducted a prospective randomized-controlled multicenter study to evaluate the effect of platform switching (PS) abutments to restore CAMLOG SCREW-LINE implants in the posterior mandible, when compared to platform matching (PM) abutments, over 5 years. Adult patients missing two or more adjacent teeth in the posterior mandible and with a natural tooth mesial to the edentulous site were enrolled. Patients received conventionally loaded single restorations that were followed annually. Main outcome was changes in crestal bone levels between surgery or loading and 60 months post-loading, evaluated with mixed effects models with patients and centre as random effects. Secondary outcome was survival, evaluated with the log-rank test. Significance level was set at a = 0.01. Sixty-eight patients were randomly allocated to PS (35 patients, 74 implants) or to the PM (33 patients, 72 implants). After 60 months, 60 patients with 128 implants were evaluated. Two implants failed prior to loading in the PS group and 3 implants were extracted during the follow-up in the PM group, yielding a global survival rate of 96.2% with no differences between groups (p = 0.891). After 5-years, the implants restored with platform switching abutments appear to have lower bone loss than the implants restored with standard abutments.

Ahmed A et al 2018[47] conducted a retrospective chart review of patients at the Harvard School of Dental Medicine (HSDM) who had one or more short dental implant placed and restored was performed. Certain inclusion and exclusion criteria were chosen to screen the charts. Demographic, health, and implant data were collected and analyzed by multimodel

analyses to determine failure rates and any factors that may have increased the likelihood of an implant failure. This study confirms previously identified risk factors for a failure. Short dental implants seem to be a viable option for replacing missing teeth in strictly controlled conditions, including conditions related to the oral environment and the overall health of subjects. The periodontist and restorative dentist need to analyze all related factors during planning the treatment and selecting appropriate implant dimensions and design.

Thoma D et al 2018 [48] evaluated the implant survival rate between short dental implants and standard length implants placed in combination with bone grafting at 5years of loading. This multicentre study enrolled 101 patients (137implants) with a posterior maxillary bone height of 5–7 mm. Patients randomly received either short implants (6mm ; GS) or long implants(11–15mm) with sinus grafting (GG). Six months later, implants were loaded with single crowns and patients re-examined at 1,3and 5years of loading. Outcomes included: implant survival, marginal bone levels (MBLs), biological and technical parameters and patient reported outcome measures (OHIP-49=Oral Health Impact Profile). Statistical analysis as performed using an on-parametric approach. Both treatment modalities were suitable for implant therapy in the atrophied posterior maxilla revealing no differences in terms of survival rates, marginal bone levels (changes), patient reported out comes and technical/biological complications.

Ravida A et al 2018[49] conducted a meta-regression analysis study which determined the effect of bone augmentation procedures and the influence of other clinical covariates on the results. Eighteen studies comprising 1612 implants (793 extra-short and 820 long implants) were selected for the meta-analysis. No statistically significant difference in the survival rate being observed at 1 and 3 years ($p>0.05$). 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

($p<0.05$). Contrarily, a statistically significant small number of prosthetic complications was reported with long implants ($p<0.05$) .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 years follow-up. However, the long term effectiveness of extra-short dental implants remains to be further studied.

MATERIALS & METHODS

PATIENT SELECTION:

The patients who participated in the study were selected from out-patients who visited the Department of Periodontology, Best Dental Science College& hospital, Madurai. A total of 14 patients including both males and females aged between 18-55 years were selected and informed consent was obtained from all the participants (Annexure-II) according to WORLD MEDICAL ASSOCIATION DECLARATION OF HELSINKI[50]. The study subjects were clinically (using UNC-12 plastic probe) and radiographicaly (CBCT) evaluated.

The study protocol was approved by the Institutional Ethical Committee and Review Board (23-2-2018). Written and verbal consent was obtained from the selected patients. All the patients included in the study satisfied the following inclusion and exclusion criteria.

INCLUSION CRITERIA:

1. Patients (male or female) with age range 18-55 years of either sex with missing teeth in one or both maxilla or mandibular arches.
2. Patients having a healthy edentulous site of single missing tooth with intact adjacent and healthy opposing teeth.
3. Presence of adequate bone volume to accommodate an implant of appropriate size.
4. Patients having good systemic health with no contraindications for surgery.
5. Patients with good oral hygiene.

EXCLUSION CRITERIA:

1. Insufficient bone quantity and quality.
2. Patients with habit of smoking.
3. Sites with acute infection.

4. Dental history of bruxism, parafunctional habits and / or lack of stable posterior occlusion.
5. Patients with TMJ disorders.
6. Pregnant or lactating women.
7. Patients have receiving any radiation therapy in the head and neck area.

STUDY DESIGN:

Subjects were selected according to the above mentioned inclusion and exclusion criteria. The medical and dental history was recorded. Scaling was done 1 week prior to surgery and oral hygiene instructions were given. Irreversible hydrocolloid (COLTENE COLTOPRINT chromatic alginate, manufacture by COLTENE WHALEDENT Pvt.Ltd., India) impression of the surgical site and the opposite arch were taken using standard trays. Acrylic surgical template was fabricated and used to maintain the precision of the osteotomy. Preoperative CBCT was done to estimate the bone quality and width of the bone at the alveolar crest of the edentulous area. **It** also measures the distance from the crest to the inferior alveolar canal (width & length), maxillary sinus and mental foramen, so as to maintain a 2mm clearance. Accordingly the adequate size of implant was chosen.

ARMAMENTARIUM:

ARMAMENTARIUM FOR CLINICAL EVALUATION:

1. Mouth mirror.
2. Explorer.
3. UNC- 12 Plastic probe.

ARMAMENTARIUM FOR SURGERY:

1. Mouth mirrors
2. Probes
3. Explorers

4. Tweezers
5. UNC- 12 Plastic probe.
6. William’s periodontal probe
7. B.P.handle no.3
8. Blade No.12
9. Blade No.15
10. Metal Suction Tip
11. Austin’s Retractor
12. Straight/Curved Artery Forceps
13. Toothed Tissue Forceps
14. Periosteal Elevator
15. Castrovejo Needle holder
16. Goldman-Fox tissue cutting scissors
17. Suture cutting scissors
18. kidney tray
19. Dentium physiodispenser
20. Dentium implant kit
21. 2ml syringe loaded with 2% lignocaine HCL with 1: 80,000 adrenaline
22. Normal saline (NS-eurolife)
23. Povidone iodine
24. Disposable gloves, face masks and head cap
25. Suture material (3-0 black silk suture)
26. Disposable syringes-2 ml and 10 ml.

DENTIUM IMPLANT KIT

1. First guide drill
2. Second guide drill
3. Final drill (Stopper)
4. Final drill
5. Countersink
6. Parallel pin x4
7. Hand-piece adapter
8. Ratchet adapter
9. Path pin x2
10. Hex driver
11. Drill extension
12. Depth gauge
13. Ratchet

CLINICAL PARAMETERS:

2. Clinical Parameters:

- Modified Plaque index- (MOMBELLI et al, 1987) baseline, 3 months, 6 months, 9 months, 12 months.
- Gingival index- (LOE and SILLNESS 1964) baseline, 3 months, 6 months, 9 months, 12 months.
- Probing depth will be recorded at four sites (mesial, distal, facial and palatal).3months, 6 months, 9 months, and 12 months with using UNC-12 plastic probe.
- Implant mobility (MISCH, 1999). 3months, 6 months, 9 months, 12 months

- **3. CBCT-** CBCT analysis will be done at baseline, 3 months (the time of crown placement), 9 months (after crown placement) to assess the peri-implant marginal bone level changes around the implants.

2. Clinical Parameters:

- **Modified Plaque index (Mombelli et al, 1987)** [68]

SCORE	CRITERIA
0	No detection of plaque
1	Plaque only recognized by running a probe across the smooth marginal surface of the implant. Implants covered by plasma spray in this area always score 1
2	Plaque can be seen by naked eye
3	Abundance of soft matter

Calculation of plaque index:

PI for the area: Each area (distal-facial, mesial-facial, facial and lingual) is assigned a score from 0-3

PI for a tooth: The scores from the four areas are calculated and divided by four.

PI score for the individual: The score from each of the tooth were added and then divided by the total number of teeth examined

INTERPRETATION:

Excellent	**0**
Good	**0.1-0.9**
Fair	**1.0-1.9**
Poor	**2.0-3.0**

- **Gingival Index (Loe and Sillness 1964)** [52]

SCORE	CRITERIA
0	Normal mucosa
1	Mild inflammation
2	Moderate inflammation (Redness, edema and glazing)
3	Severe inflammation (Marked redness, edema, ulceration as shown by spontaneous bleeding)

Instrument used: Mouth mirror and periodontal probe.

Calculation:

GI for the area: Each area (distal-facial, mesial-facial, facial and lingual) is assigned a score from 0-3

GI for a tooth: The scores from the four areas of the tooth are added and then divided by four.

GI score for the individual: The score from each of the tooth were added and then divided by the total number of teeth examined. The scores range from 0 to3.

INTERPRETATION:

Gingival score	Conditions
0.1-1.0	Mild gingivitis
1.1-2.0	Moderate gingivitis
2.1-3.0	Severe gingivitis

- **Probing depth**[53]

Probing depth was recorded with a periodontal probe, from the crest of gingival margin to the base of the peri-implant sulcus. Probing depth was recorded at mesial, distal, facial & lingual surfaces using **UNC-12 plastic probe**, with millimeter markings.

- **Mobility scale was tested manually and graded according to clinical implant mobility scale (Misch, 1999)** [54]**.**

SCALE	*DESCRIPTION*
0	Absence of clinical mobility with 500gm in any direction
1	Slight detectable horizontal mobility
2	Moderate visible horizontal mobility upto 0.5mm
3	Severe horizontal movement greater than 0.5mm
4	Visible, moderate to severe horizontal and any visible vertical movement

3. A CBCT STUDY:

CBCT scan: Cone Beam Computed tomographic scans were done to assess the quantity as well as quality of bone around the Implant. Evaluation of the buccal bone level (BBL), lingual bone level (LBL), mesial bone level (MBL) and distal bone level (DBL) were performed with the use of Cone beam CT scanner. CBCT machine which is used to scan is NEWTOM GO, manufactured in Italy.

Maximum field of view by this CBCT machine is 10×10 cm in size. We have analyzed cases with small field of view that is 6×6 cm in size with the resolution of 115 microns. Basic axial slice set up by this machine is 0.15 mm, so that we get the accurate data. According to literature CBCT voxels are isotrophic so that all measurements are accurate.

We have performed CBCT scan before and immediately after implant placement and 9 months after crown placement. The focal planes were adjusted to the center of the buccolingual aspect of the implant and the mesiodistal aspect.

NNT software was used to analyze the CBCT data. Vertical bone resorption was measured from the shoulder of implant to the alveolar ridge using the measuring tool present in the CBCT. From the coronal section, buccal and lingual vertical bone loss was measured and from sagittal section, mesial and distal vertical bone loss was measured. Multiplanar reconstruction was used to analyze mesio-buccal, disto-buccal, mid-buccal, mesio-lingual, disto-lingual and mid-lingual sites.

Types of bone	*Density in Hounsfield units*
D_1	>1250 Hounsfield units
D_2	850 – 1250 Hounsfield units
D_3	350 – 850 Hounsfield units
D_4	150 – 350 Hounsfield units

The amount of bone, mesial and distal of edentulous single tooth site was measured using the CBCT scan. The amount of bone present beyond the root tips i.e. amount of bone between the nasal floor and apex of the root was also measured. Selection of the width and length of implants were done according to these CBCT scan measurements. The quality of bone was assessed with the help of bone density obtained through the CT scan. Bone density was assessed using Hounsfield units. Quality of bone was grouped into D_1, D_2, D_3 and D_4 types of bone (misch)

IMPLANT SYSTEM USED IN THIS STUDY:

The implant system used in this study was **SuperLine Dentium implant system.**

Drills:

The kit contains 6 universal drill of diameters **D Ø3.6, D Ø4.0, D Ø4.5, D Ø5.0, D Ø6.0, D Ø7.0mm**. Superline color Coding by diameter with corresponding **Yellow, Green, Blue, Red, Orange, Violet** All drills are having easily identifiable depth markings at 8mm, 10mm,12mm, 14mm.

These implants are color coded and are of the following dimensions:

COLOR	*PLATFORM*	*BODY*	*LENGTH*
Yellow	Ø 3.6	Ø 3.6	7
			8
			10
			12
			14
Green	Ø 4.0	Ø 4.0	7
			8
			10
			12
			14

Blue	Ø 4.4	Ø 4.5	7
			8
			10
			12
			14
Red	Ø 4.9	Ø 5.0	7
			8
			10
			12
			14
Orange	Ø 6.0	Ø 5.0	7
			8
			10
			12
Violet	Ø 7.0	Ø 5.8	7
			8
			10
			12

Dentium SuperLine Dental Implant:

Fig 4 : Dentium SuperLine Dental Implant

Countersink Depth Guide:

- Drilling depth of the countersink depends on the patient's bone quality. If the bone density is **D1~D2**, it is recommended to drill up to the top line (I) of laser mark on the countersink.
- If the bone density is **D3~D4**, it is recommended to drill up to the bottom line (II) of laser mark on the countersink.
- Countersink drill is used in cases with dense cortical bone.
- If the bone density is **D1~D3**, it is recommended to countersink after final drill.
- The actual diameter of the Countersink drill is 0.1mm larger.

THE CHARACTERISTICS OF THE IMPLANT USED WAS

1. S.L.A.Surface – (Sandblasting with large grit and acid etching)

- Higher bone- to –implant contact.
- Faster bone formation on the surface.

2. Tapered Design-

- Tapered load distribution may achieve excellent bone response.
- Tapered design may harmonize with surrounding bone anatomically.
- The large surface area helps provide excellent initial stability with sinus augmentation.

3. Biological Connection

- The conical hex connection between implant and abutment interface ensures hermetic sealing.
- The biologic connection distributes the load to the fixture evenly. Therefore it helps minimize micro-movement and marginal bone loss.
- All implant diameters share the same internal hex.

4. Double thread and Thread height

- Increased thread height helps increase the initial stability.
- Double thread may decrease the chair time of implantation.

6. Osseointegration

- The greater distance between the threads may promote early osseointegration.

7. Prosthesis

- One abutment screw fits all abutments and fixture platforms.
- Single abutment connection is used for all implant diameters.
- One hex screw driver fits all abutment screws.

These characteristics of the implant surface may influence the survival rate of short dental implants.

Investigations:

Complete haemogram, which included Hb mg%, bleeding time and clotting time, differential count, total count, INR were done to evaluate the fitness of the patient for stage I surgery or implant placement.

Pre-surgical protocol:

Study models and wax patterns were prepared for each patient. Occlusal analysis was performed over the study models and surgical stents were prepared. Oral prophylaxis was done 15days before the planned implant placement. Patients were advised to use chlorhexidine gluconate 0.2% mouthwash, twice daily for a period of 15 days. Adequate instructions were given on oral hygiene maintenance and its importance on the success of implant therapy.

Pre-medication:

Dexamethasone injection -1CC intra muscular injection given pre operatively.

Decision on length and width of implants:

After evaluating the dimensions of the edentulous ridge and findings of the CBCT scan, final decision regarding the dimensions of the implant was taken.

Pre- treatment records:

1. Detailed medical and dental history.
2. Periodontal assessment using clinical parameters.
3. Diagnostic casts and surgical stent.
4. Patient complete heamatogram report

5. Cone beam Computed Tomography Scans (CBCT- Scans) were taken to identify the anatomical landmarks.
6. Clinical photographs.
7. Identification of anatomic landmarks in relation to implant site was done.

SURGICAL TECHNIQUE:

A Two stage surgical protocol will be followed.

First stage surgery:

After assessing the pre-treatment records, mid crestal incision will be given and a full thickness flap at the proposed implant placement site will be elevated. Two types of guide drilling burs were available in this implant kit. First guide drill, second guide drill. First guide drill Ø 2.2 mm done with osteotomy. The first guide drill is followed by second guide drill Ø2.6mm, to increase the width of osteotomy site. This guide drills to increase the width and length of the osteotomy site. Drilling was done at a speed of 1000-1500 rpm with cool saline irrigation. Following a Sequential final drilling, a dental implant of appropriate size and length would be placed in the prepared osteotomy site, followed by cover screw placement. The surgical wound will be closed by sutures. All drilling was done with a speed of 1000-1500 rpm with cool saline irrigation. Countersink drill is used in case with dense cortical bone. If the bone is **D1~D2**, it is recommended to Countersink after final drill. The actual diameter of the Countersink drill is 0.1mm larger than the fixture platform.

After the final drilling, the implant was inserted with the help of an insertion tool and a torque ratchet. Minimum 35 to 40 Ncm of torque was achieved to ensure primary stability. After complete insertion of the implant into the bone1 or 2 mm below the alveolar crest, cover screw was placed and the surgical site was thoroughly irrigated with sterile saline. Proper closure of flaps was achieved by suturing, with 3-0 black silk suture.

Post surgical instructions:

Subjects were prescribed antibiotics (Amoxicillin 500 mg + Clavulanic acid 125mg thrice daily), analgesics (Aceclofenac 100mg + Paracetamol 500mg twice daily) and antacid (Pantaprazole 40mg twice daily) for five days. Povidone iodine 2% oral rinse was also prescribed to facilitate plaque control. Subjects were advised to apply ice pack to the area intermittently for 20 minutes over the first 24 to 48 hours to avoid postoperative swelling. Subjects were instructed to maintain oral hygiene, to take soft diet for the first few days and then gradually return to a normal diet. Subjects were recalled after 7 days for suture removal.

Second stage surgery:

After 8-10 weeks for mandibular arch, 12-14 weeks for maxillary arch 2nd stage of surgery was done by confirming the osseointegration of the implant. Cover screw was removed and gingival former was placed. Simple interrupted sutures were placed. After one week gingival former was removed and impression coping was placed and rubber base impression material (FLEXCEED vinyl polysiloxane impression material, manufactured by GC DENTAL PRODUCTS CORP, JAPAN) was used to record the details by closed tray method. Gingival former was placed again, after removing impression coping. Impression with impression coping, and implant analog were given to lab, Screw retained platform switched ceramic prosthesis was fabricated and delivered to the subjects by tightening the screw around 25Ncm. The hole was filled with light-cured universal nano hybrid compactable composite (SOLARE Sculpt manufactured by GC DENTAL CORP, JAPAN).

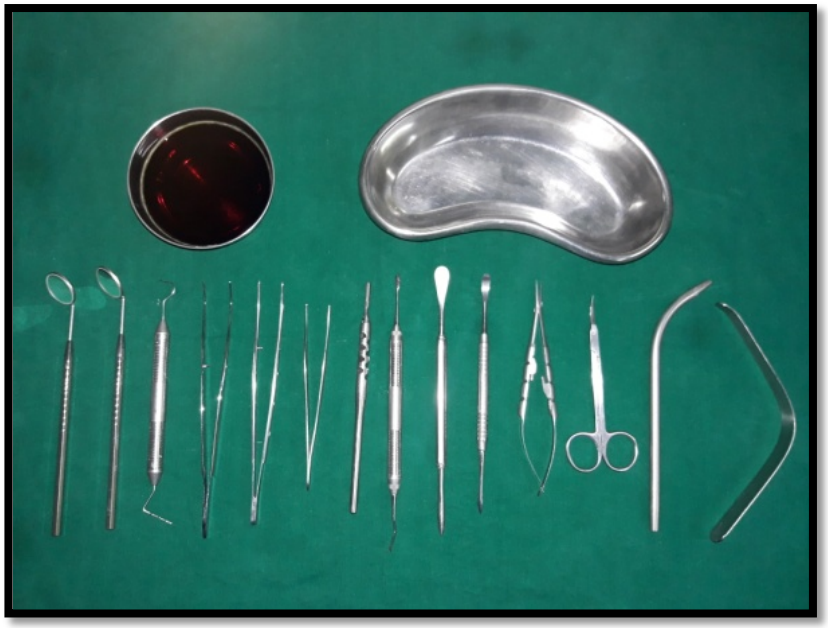


Fig 5: A. Armamentarium for the surgery

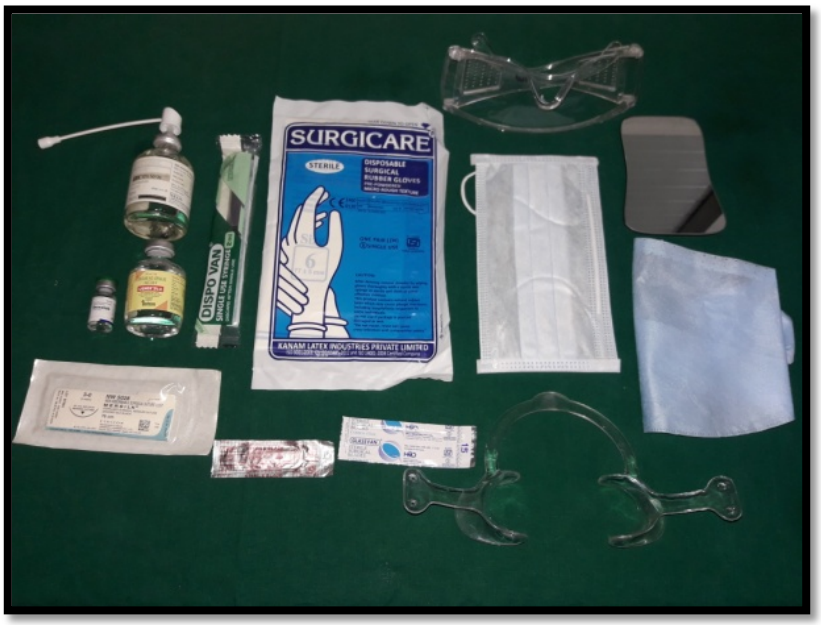


Fig 6: B. Armamentarium for the surgery

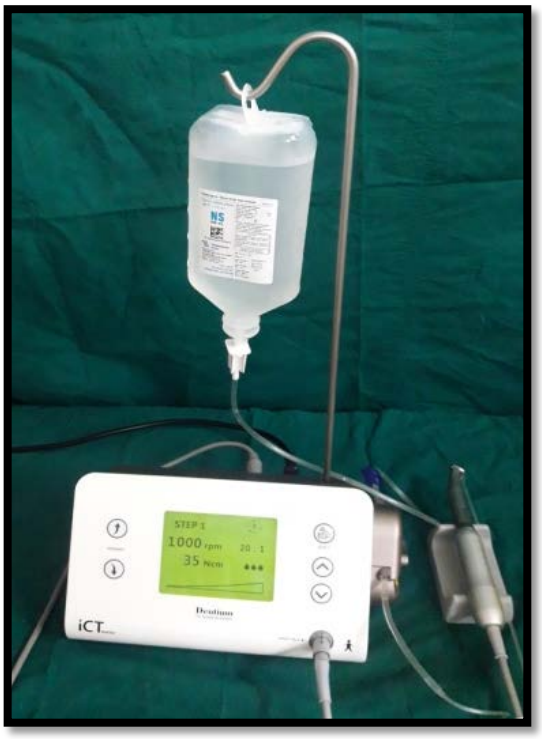


Fig 7: DENTIUM Physiodispenser unit

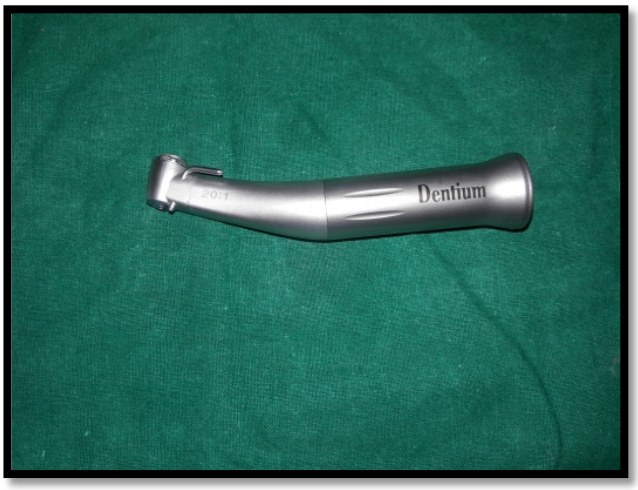


Fig 8: DENTIUM Implant contra angle handpiece

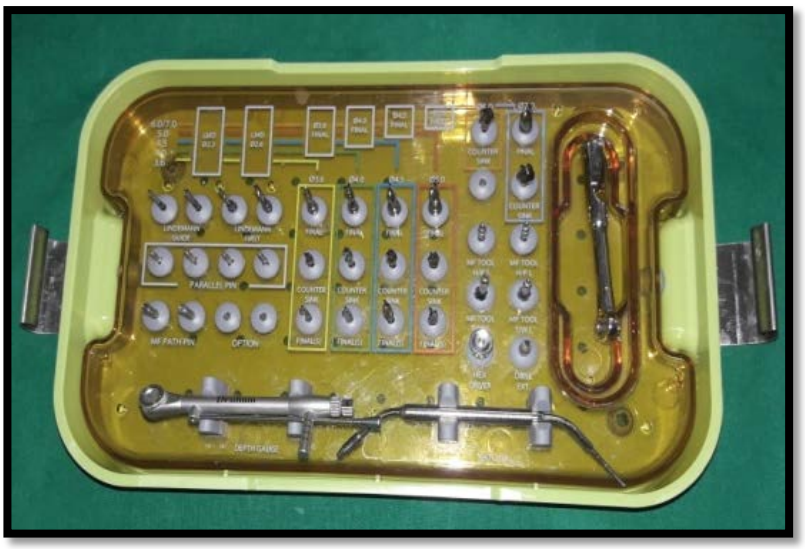


Fig 9 : DENTIUM implant kit

Fig 10 : Torque ratchet

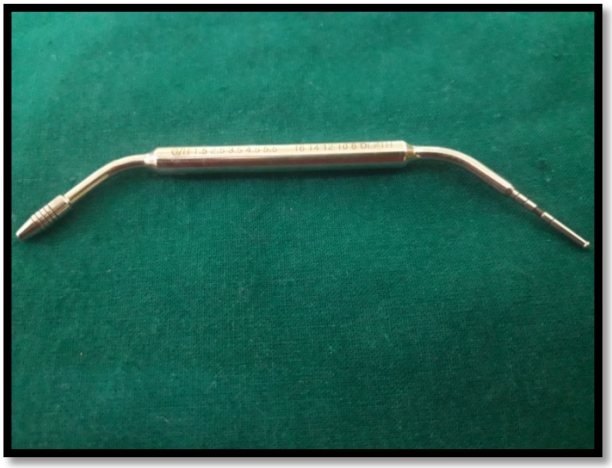


Fig 11: Gingival/ Height & Depth Gauge

Fig 12: Drills & Countersink

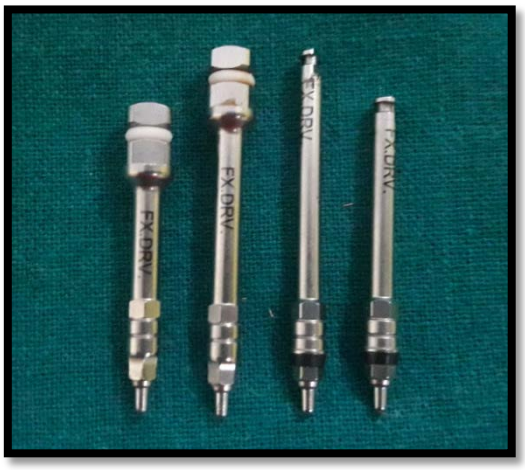


Fig 13: Ratchet adapter & Hand-piece adapter

Fig 14: Hex driver & Drill extension

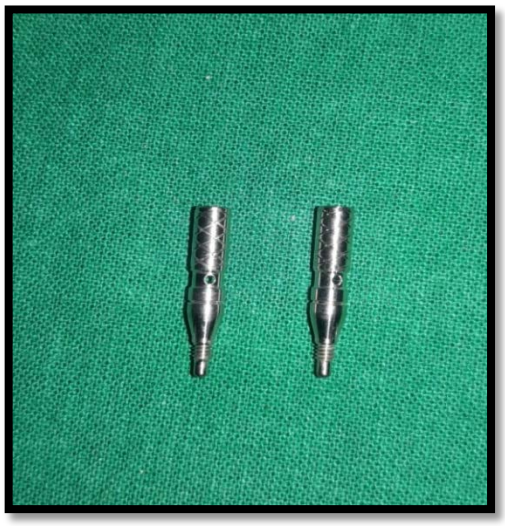


Fig 15: Path pin x2

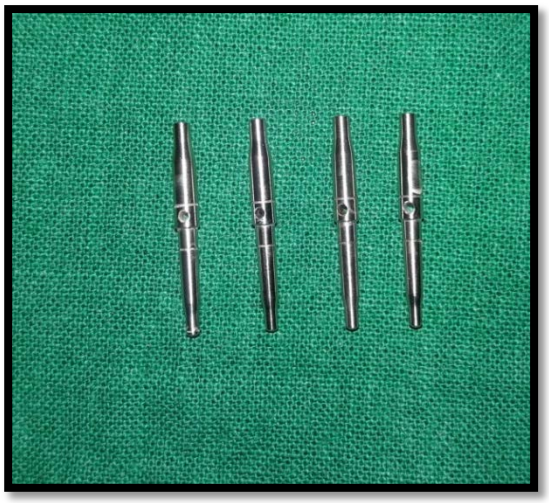
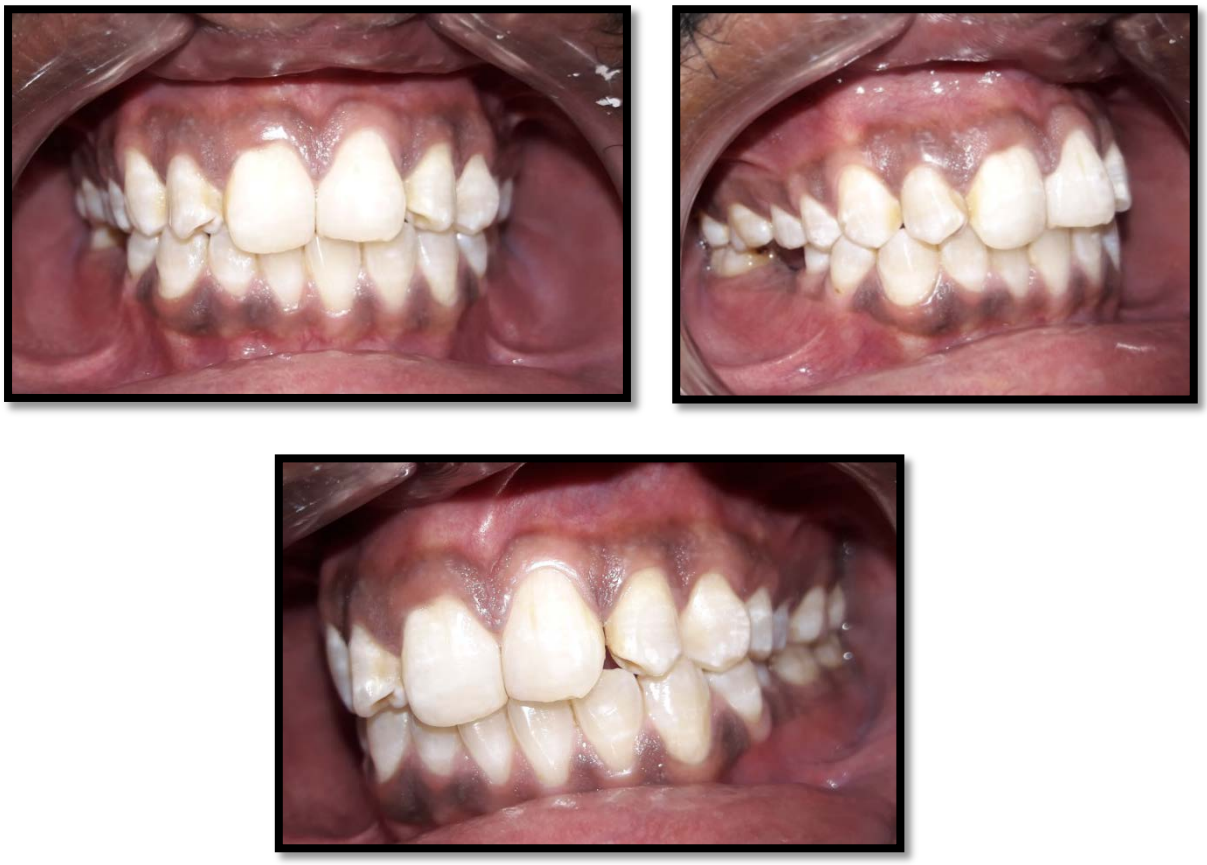


Fig 16: Parallel pin x 4

Fig 17: UNC-12 Plastic Probe

Fig 18: CBCT Unit

Fig 19: Pre operative view of patient occlusion



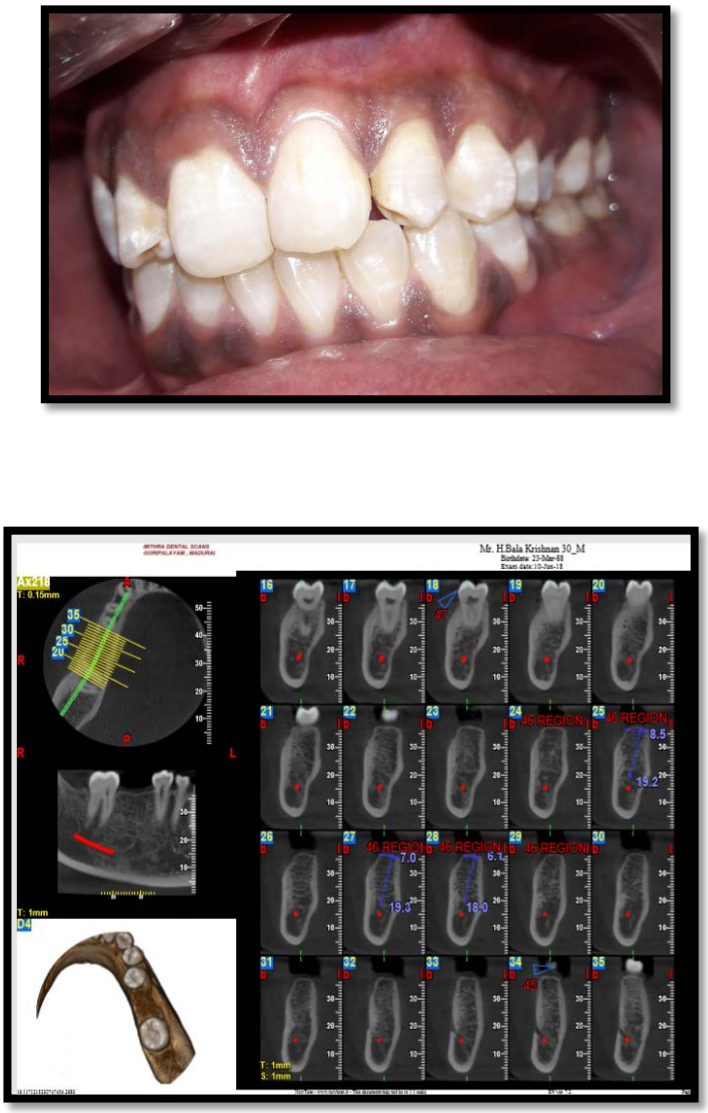


Fig 20: CBCT-Pre operative view

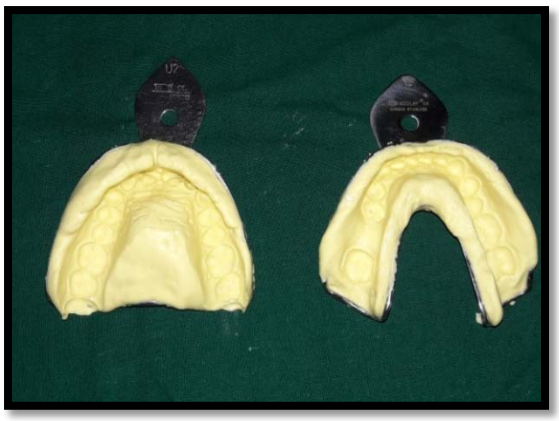


Fig 21: Pre- operative impression

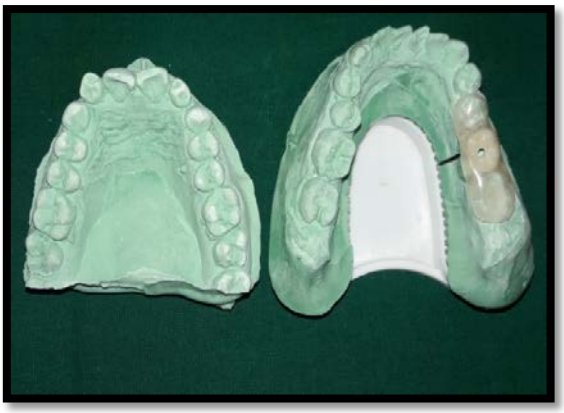


Fig 22: Study cast with surgical template

Fig 23: Surgical template

Fig 24: Elevation of full thickness mucoperiosteal flap

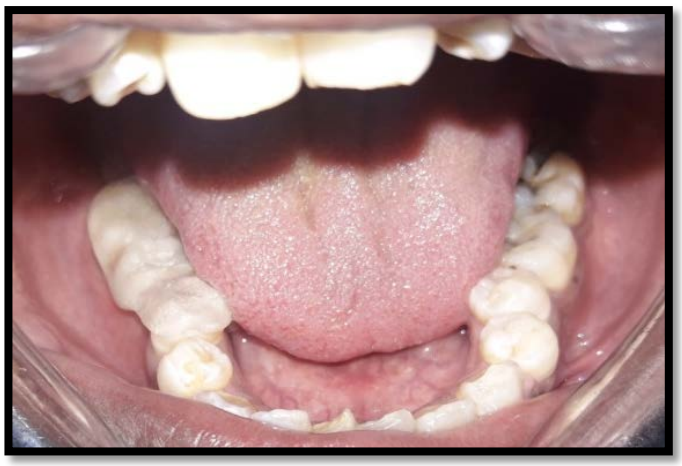


Fig 25: Surgical template placed over implant site

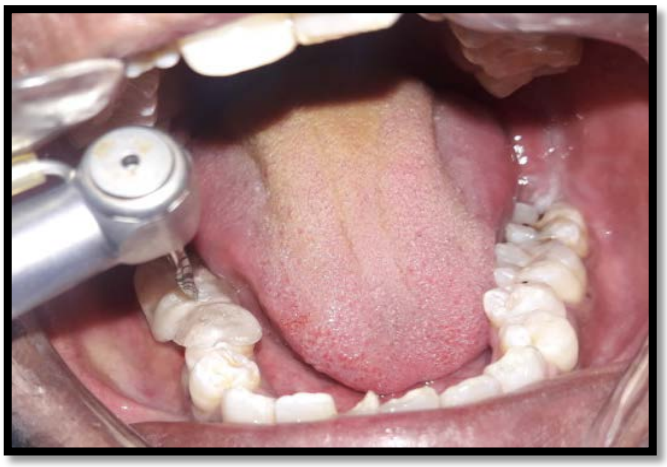


Fig 26: Ostectomy by First guide drill done

Fig 27: Second Guide Drill of 4.5mm width x 8mm length

Fig 28: Final drill done up to 5mm width x 8mm length

Fig 29: Countersink drill for appropriate width of 5mm

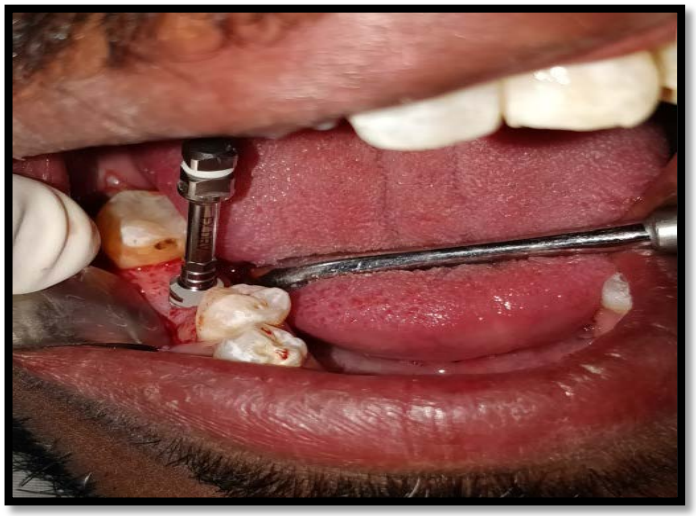


Fig 30: Implant placement

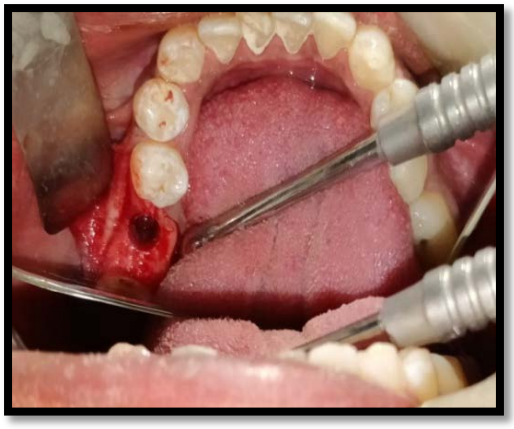


Fig 31: Implant placement done

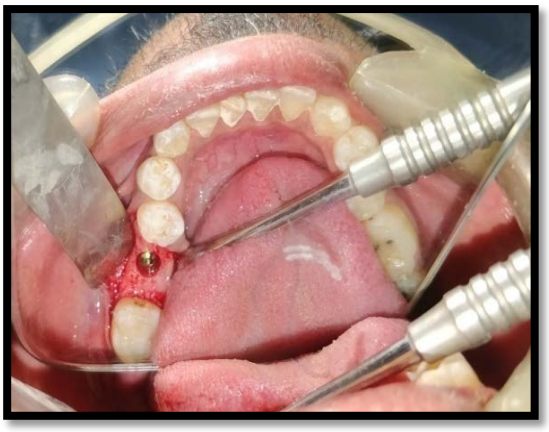


Fig 32: Placement with cover screw

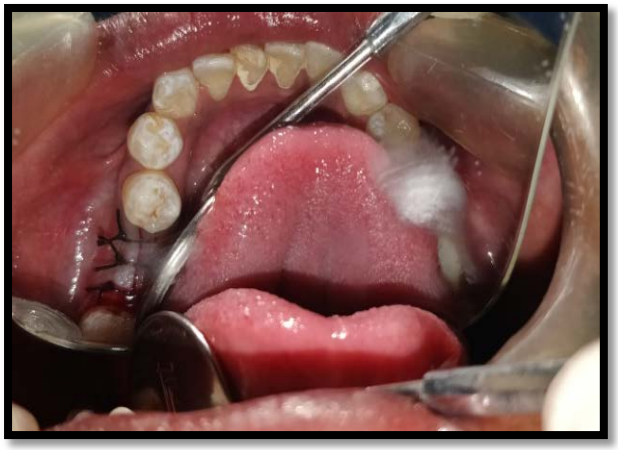


Fig 33: Suture placement done

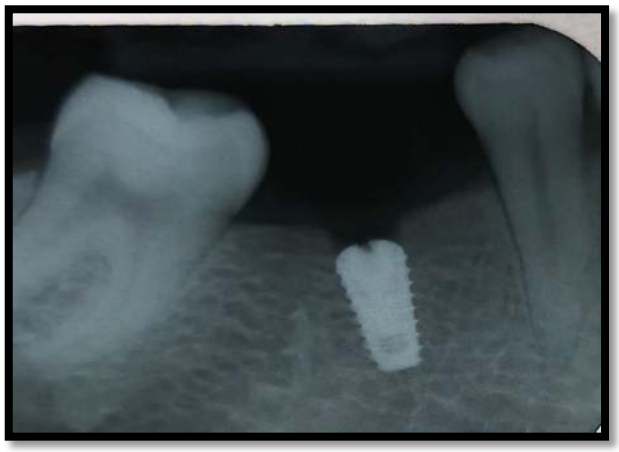


Fig 34: IOPA taken on the day of implant placement

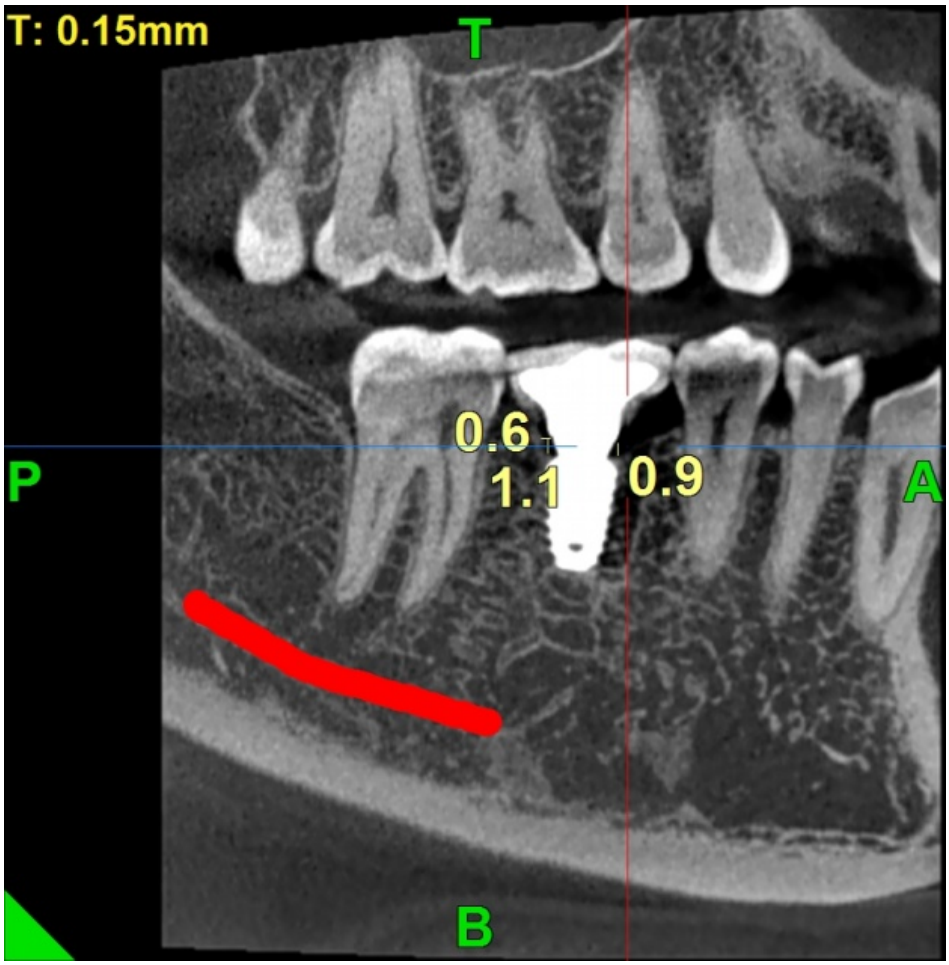


Fig 35: CBCT after 3 months of implant placement

(At the time of crown placement)

Fig 36: Second stage surgery (cover screw exposed)

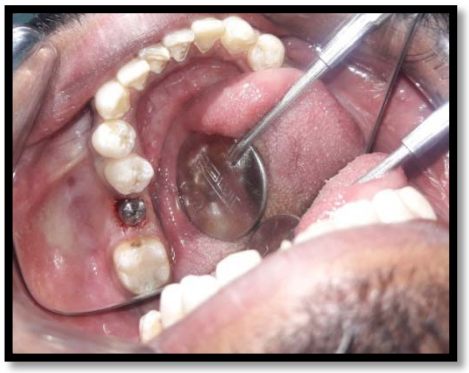


Fig 37: Gingival former placed

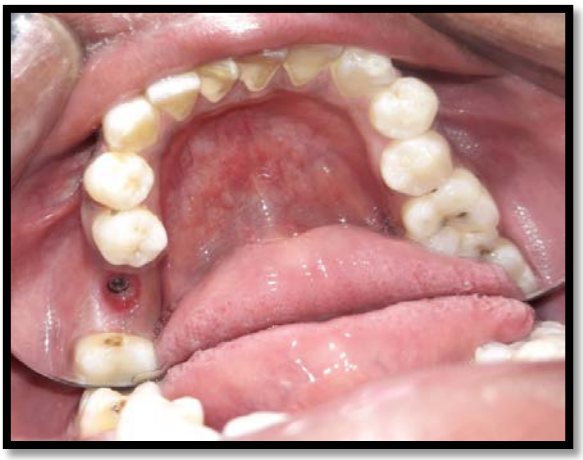


Fig 38: Formation of gingival collar

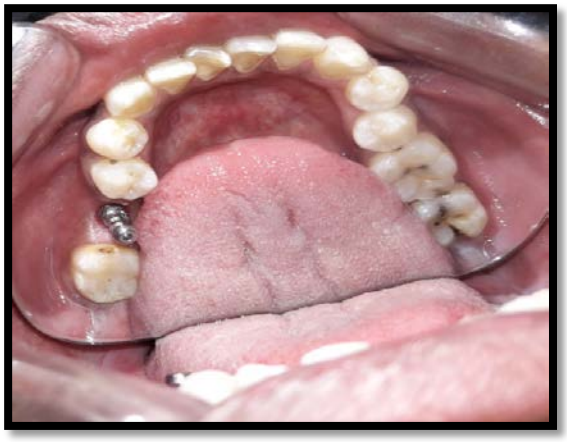


Fig 39: Placement of impression coping

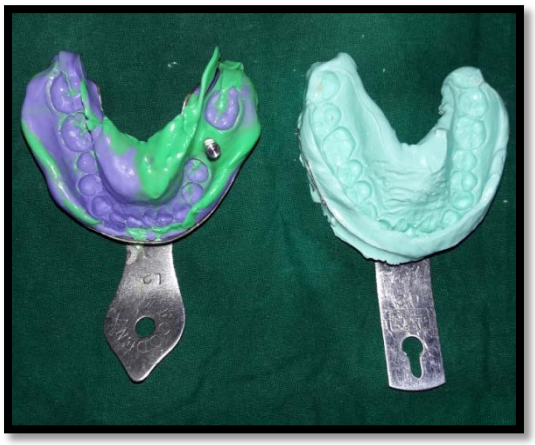


Fig 40: Closed tray impression technique

Fig 41: Jigg trial in cast

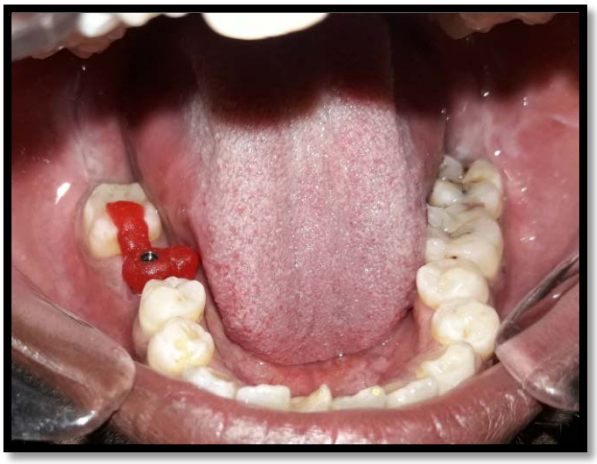


Fig 42: Jigg trial done

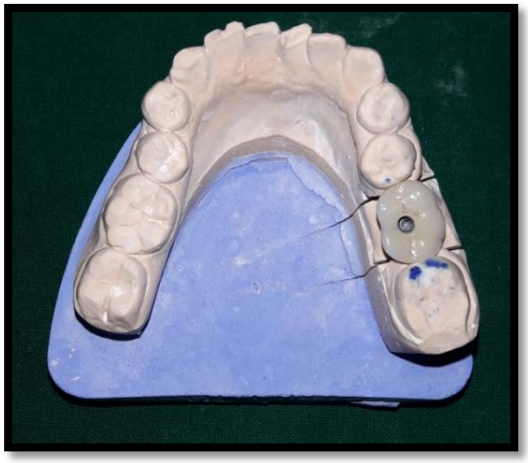


Fig 43: Fabricated Screw retained crown in cast

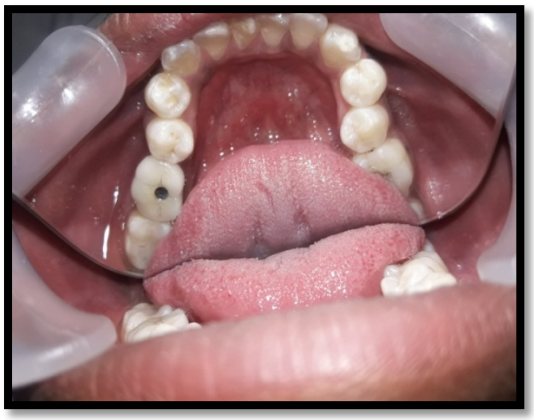


Fig 44: Implant prosthesis done in 46

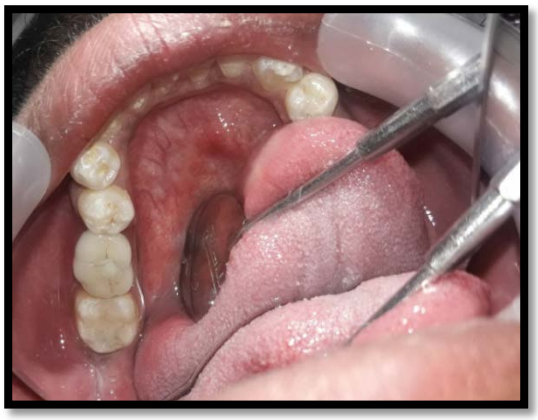


Fig 45: Screw hole filled with Composite

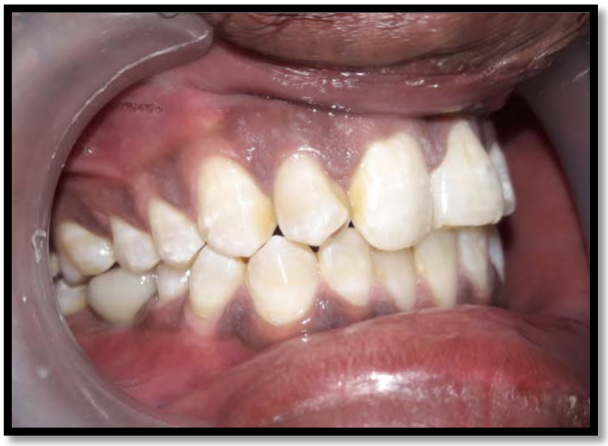


Fig 46: Occlusion of implant prosthesis site in 46

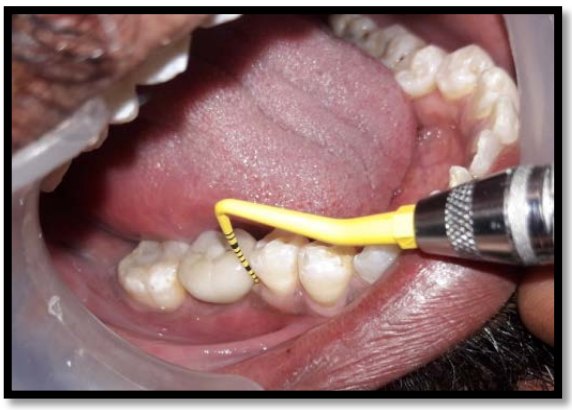


Fig 47: Evaluation of Probing pocket depth immediately after implant prosthesis with using UNC-12 Plastic Probe

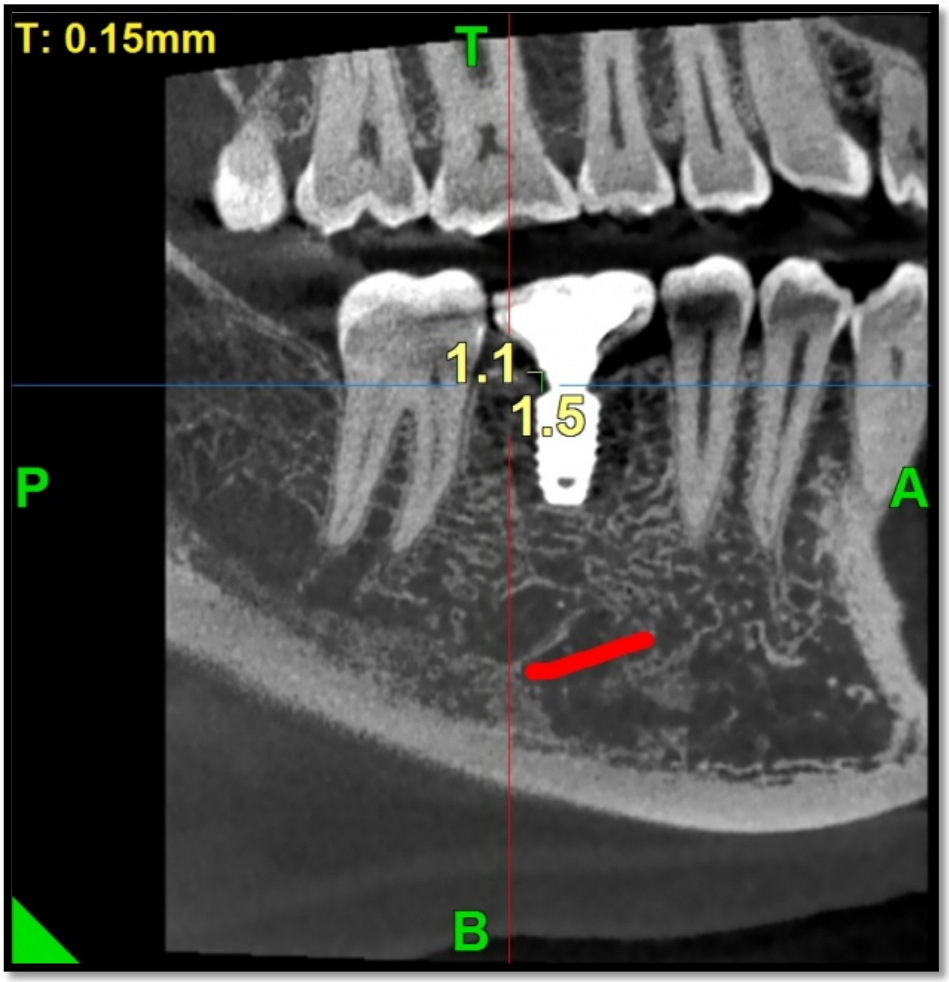


Fig 48: CBCT at 12 months of implant placement

(9 months after crown placement)

STATISTICAL ANALYSIS

The data obtained during the course of the study was entered in **Microsoft Excel** and analyzed using **SPSS software version 22 (**IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Descriptive statistics and repeated measures **ANOVA w**as employed to compare the means of various clinical and radiological parameters. Least significant difference was performed as post hoc to know the statistically significant pair. Significance level was set at $p \leq 0.05$.

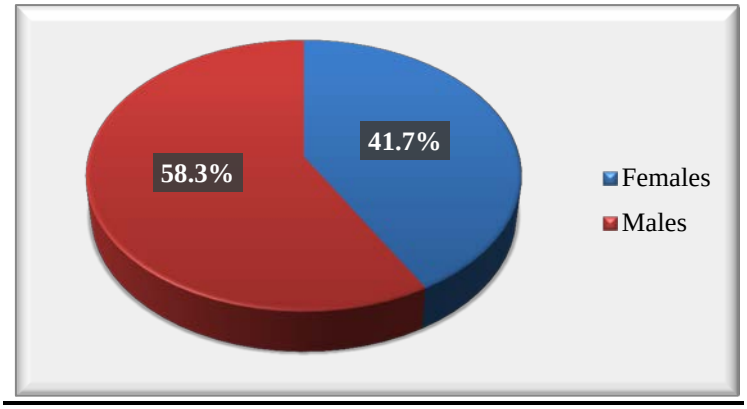
RESULTS

The present study was conducted in department of Periodontology and Oral Implantology, Best dental science college and hospital, Madurai, to assess and compare the peri- implant marginal bone level in single crowns supported short dental implants. A total of 14 subjects satisfying the selection criteria were included in the study.

The clinical parameters, Modified plaque index, Gingival index, Probing depth and Implant Mobility scale at crown placement is estimated at 6months, 9months and 12 months after crown placement and peri- implant marginal bone level changes around dental implants using CBCT analysis at 3 months (at the time of crown placement), and 9 months after crown placement. The result thus obtained were tabulated and subjected to statistical software 22 version (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.).

The total number of implants included in the study was 14. Totally 14 participants completed the study. There were seven males (58.3%) and five females (41.7%) in the study. The mean age of the participants was 34.42 ± 9.57 years with minimum of 19 years and maximum of 56 years.

Graph: 1 Gender distribution of the participants (in %)



CLINICAL PARAMETERS:

Table 1: Descriptive statistics of clinical parameters at baseline

Parameter	Minimum	Maximum	Mean	Std. Deviation
Modified Plaque Index	1.0	2.0	1.54	0.31
Gingival Index	0.70	2.00	1.26	0.47

Table 1: Describes the descriptive statistics of clinical parameters at baseline. The mean modified plaque index score was 1.54 ± 0.31 with a minimum score of 1.0 and a maximum score of 2.0. The mean gingival index score was 1.26 ± 0.47 with a minimum score of 0.70 and maximum score of 2.0.

Table 2: Descriptive statistics of clinical parameters at 3 months

Parameter	Minimum	Maximum	Mean	Std. Deviation
Modified Plaque Index	0.90	1.90	1.23	0.40
Gingival Index	0.70	1.80	1.09	0.43
Probing depth	1.0	1.7	1.21	0.27

Table 2: Describes the descriptive statistics of clinical parameters at 3 months. The mean modified plaque index score was 1.23 ± 0.40 with a minimum score of 0.9 and a maximum score of 1.90. The mean gingival index score was 1.09 ± 0.43 with a minimum score of 0.70 and maximum score of 1.80. The mean probing depth was 1.21 ± 0.27 mm with a minimum and maximum probing depth of 1.00 mm and 1.7 mm respectively.

Table 3: Descriptive statistics of clinical parameters at 6 months

Parameter	Minimum	Maximum	Mean	Std. Deviation
Modified Plaque Index	0.70	1.80	1.11	0.38
Gingival Index	0.6	1.9	1.00	0.43
Probing depth	1.0	2.0	1.58	0.35

Table 3: Describes the descriptive statistics of clinical parameters at 6 months. The mean modified plaque index score was 1.11 ± 0.38 with a minimum score of 0.7 and a maximum score of 1.80. The mean gingival index score was 1.00 ± 0.43 with a minimum score of 0.60 and maximum score of 1.90. The mean probing depth was 1.58 ± 0.35 mm with a minimum and maximum probing depth of 1.00 mm and 2.0 mm respectively.

Table 4: Descriptive statistics of clinical parameters at 9 months

Parameter	Minimum	Maximum	Mean	Std. Deviation
Modified Plaque Index	0.7	1.8	1.11	0.43
Gingival Index	0.50	1.70	0.99	0.38
Probing depth	1.5	2.0	1.76	0.23

Table 4: Describes the descriptive statistics of clinical parameters at 9 months. The mean modified plaque index score was 1.11 ± 0.43 with a minimum score of 0.7 and a maximum score of 1.80. The mean gingival index score was 0.99 ± 0.38 with a minimum score of 0.50 and maximum score of 1.70. The mean probing depth was 1.76 ± 0.23 mm with a minimum and maximum probing depth of 1.50 mm and 2.0 mm respectively.

Table 5: Descriptive statistics of clinical parameters at 12 months

Parameter	Minimum	Maximum	Mean	Std. Deviation
Modified Plaque Index	0.5	1.8	1.06	0.44
Gingival Index	0.5	1.7	0.94	0.40
Probing depth	1.5	2.2	1.84	0.26

Table 5: Describes the descriptive statistics of clinical parameters at 12 months. The mean modified plaque index score was 1.06 ± 0.44 with a minimum score of 0.5 and a maximum score of 1.80. The mean gingival index score was 0.94 ± 0.40 with a minimum score of 0.50 and maximum score of 1.70. The mean probing depth was 1.84 ± 0.26 mm with a minimum and maximum probing depth of 1.50 mm and 2.2 mm respectively.

Table 6: Comparison of Gingival index across the timeline

Time	Mean	SD	F value	p value
Baseline	1.26	0.47	8.605	0.012
3 months	1.09	0.43		
6 months	1.00	0.43		
9 months	0.99	0.38		
12 months	0.94	0.40		

F and p value obtained from Repeated measures ANOVA

p value ≤ 0.05 is significant

Table 6: Reports the comparison of gingival index across the various time periods (baseline, 3, 6, 9, 12 months). On comparing the means, the difference between the means was found to be statistically significant with F value of 8.605 and a p value of 0.012.

Table 7: Pair wise comparison across the time line

Group	Group	Mean difference	p value	95% CI for difference	
				Lower	Upper
1	2	0.167*	**0.017**	0.035	0.300
	3	0.255*	**0.013**	0.064	0.446
	4	0.270*	**0.013**	0.066	0.474
	5	0.312*	**0.008**	0.098	0.527
2	3	0.088	0.120	-0.026	0.202
	4	0.103	0.107	-0.025	0.231
	5	0.145*	**0.049**	0.000	0.290
3	4	0.015	0.673	-0.060	0.090
	5	0.057	0.071	-0.006	0.120
4	5	0.042*	**0.042**	0.002	0.083

p value obtained from Least Significant Difference test.

p value ≤ 0.05 is significant

CI - Confidence Interval. Lower and upper bounds for CI

Groups: 1 - baseline, 2 - 3 months, 3 - 6 months, 4 - 9 months,

5 - 12 months

Table 7: Shows the pair wise comparison between the various time periods for gingival index. It was found that the difference between the following time periods : baseline – 3months, baseline – 6 months, baseline – 9 months, baseline - 12 months, 3 – 12 months, 9 – 12 months were statistically significant with a p value of 0.017, 0.013, 0.013, 0.008, 0.049 and 0.042 respectively.

Table 8: Comparison of Modified Plaque index across the timeline

Time	Mean	SD	F value	p value
Baseline	1.54	0.31	14.909	**0.002**
3 months	1.23	0.40		
6 months	1.11	0.38		
9 months	1.11	0.43		
12 months	1.06	0.44		

f and p value obtained from Repeated measures ANOVA

p value ≤ 0.05 is significant

Table 8: Reports the comparison of modified plaque index across the various time periods (baseline, 3, 6, 9, 12 months). On comparing the means, the difference between the means was found to be statistically significant with F value of 14.909 and a p value of 0.002.

Table 9: Pair wise comparison across the time line

Group	Group	Mean difference	p value	95% CI for difference	
				Lower	Upper
1	2	0.305*	**0.003**	0.121	0.489
	3	0.424*	**0.000**	0.235	0.613
	4	0.421*	**0.002**	0.185	0.658
	5	0.471*	**0.001**	0.218	0.725
2	3	0.119*	**0.002**	0.053	0.185
	4	0.116	0.058	-0.005	0.238
	5	0.166*	**0.034**	0.015	0.318
3	4	-0.003	0.958	-0.119	0.113
	5	0.047	0.449	-0.083	0.177
4	5	0.050	0.169	-0.024	0.124

P -value obtained from Least Significant Difference test.

P -value $\leq$ 0.05 is significant

CI - Confidence Interval. Lower and upper bounds for CI

Groups: 1 - baseline, 2 - 3 months, 3 - 6 months, 4 - 9 months, 5 - 12 months

Table 9: Shows the pair wise comparison between the various time periods for modified plaque index. It was found that the difference between the following time periods : baseline – 3months, baseline – 6 months, baseline – 9 months, baseline - 12 months, 3 – 6 months, 3 – 12 months were statistically significant with a p value of 0.003, 0.000, 0.002, 0.001, 0.002 and 0.034 respectively.

Table 10: Comparison of Probing pocket depth across the timeline

Time	Mean	SD	F value	p value
3 months	1.21	0.27	147.664	**0.000**
6 months	1.58	0.35		
9 months	1.76	0.23		
12 months	1.84	0.26		

f and p - value obtained from Repeated measures ANOVA

P - value ≤ 0.05 is significant

Table 10: Reports the comparison of probing pocket depth across the various time periods (3, 6, 9, 12 months). On comparing the means, the difference between the means was found to be statistically significant with f value of 147.664 and a p-value of 0.000.

Table 11: Pair wise comparison across the time line

Group	Group	Mean difference	p value	95% CI for difference	
				Lower	Upper
1	2	-0.371*	**0.001**	-0.567	-0.176
	3	-0.550*	**0.000**	-0.695	-0.405
	4	-0.629*	**0.000**	-0.753	-0.504
2	3	-0.179*	**0.007**	-0.299	-0.058
	4	-0.257*	**0.001**	-0.385	-0.130
3	4	-0.079*	**0.043**	-0.154	-0.003

p value obtained from Least Significant Difference test.

p value ≤ 0.05 is significant

CI - Confidence Interval. Lower and upper bounds for CI

Groups: 1 - baseline, 2 - 3 months, 3 - 6 months, 4 - 9 months, 5 - 12 months

Table 11: Shows the pair wise comparison between the various time periods for probing pocket depth. It was found that the difference between all the time periods were statistically significant with various p values < 0.05.

RADIOLOGICAL PARAMETERS

Table 12: Descriptive statistics of Radiological parameters at 3 months

Sites	Minimum	Maximum	Mean	Std. Deviation
Mesial Horizontal	1.2	2.3	1.86	0.32
Mesial Vertical	1.2	2.1	1.73	0.34
Distal Horizontal	0.4	1.9	1.09	0.45
Distal Vertical	0.2	1.3	0.81	0.38

Table 12 : Describes the radiological parameters at 3 months. The mean bone loss at the mesial horizontal site was 1.86 ± 0.32 mm with a minimum of 1.2 mm and a maximum of 2.3 mm. The mean bone loss at the mesial vertical site was 1.73 ± 0.34 mm with a minimum of 1.2 mm and a maximum of 2.1 mm. The mean bone loss at the distal horizontal site was 1.09 ± 0.45 mm with a minimum of 0.40 mm and a maximum of 1.09 mm. The mean bone loss at the distal vertical site was 0.81 ± 0.38 mm with a minimum of 0.2 mm and a maximum of 1.3 mm.

Table 13: Descriptive statistics of Radiological parameters at 12 months

Sites	Minimum	Maximum	Mean	Std. Deviation
Mesial Horizontal	1.5	2.1	1.81	0.19
Mesial Vertical	1.2	2.1	1.69	0.27
Distal Horizontal	0.5	1.8	1.06	0.33
Distal Vertical	0.2	1.2	0.76	0.29

Table 14: Comparison of Bone loss at various sites between 3 and 12 months

Site	Months	Mean	SD	t value	p value	95% CI for difference	
						Lower	Upper
Mesial horizontal	3	1.86	0.32	0.589	0.566	-0.1525	0.2668
	12	1.81	0.19				
Mesial vertical	3	1.73	0.34	0.394	0.700	-0.1599	0.2313
	12	1.69	0.27				
Distal horizontal	3	1.09	0.45	0.295	0.773	-0.1358	0.1786
	12	1.06	0.33				
Distal vertical	3	0.81	0.38	1.202	0.251	-0.0399	0.1399
	12	0.76	0.29				

t and p value obtained from paired t test

p value ≤ 0.05 is significant

CI - Confidence Interval. Lower and upper bounds for CI

Table 14: Depicts the comparison of bone loss between 3 and 12 months at various sites (mesial horizontal, mesial vertical, distal horizontal, distal vertical). On comparing the means, the difference between the means was not found to be statistically significant. It indicates that the bone loss was minimal.

Table 15: Descriptive statistics for Overall bone loss (in mm)

Time period	Minimum	Maximum	Mean	Std. Deviation
3 months	0.2	2.3	1.37	0.57
12 months	0.2	2.1	1.33	0.51

Table 15 : Describes the overall mean bone loss at 3 months was found to be 1.37 ± 0.57 mm with a minimum of 0.2 mm bone loss and maximum of 2.3 mm bone loss. The overall mean bone loss at 12 months was found to be 1.33 ± 0.51 mm with a minimum and maximum of 0.2 mm and 2.1 mm respectively.

Table 16: Comparison of overall bone loss (in mm) between the time period

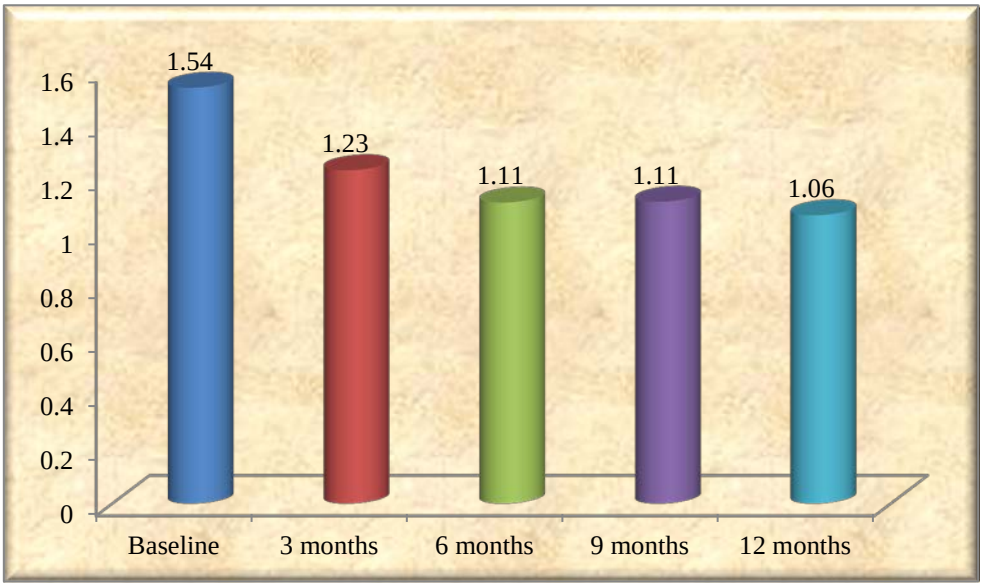
Time period	Mean	Std. Deviation	Mean difference	t value	p value	95% CI of the Diff	
						Lower	Upper
3 months	1.37	0.57	0.041	1.075	0.287	-0.0355	0.1176
12 months	1.33	0.51					

CI of the Diff. - Confidence Interval of the difference

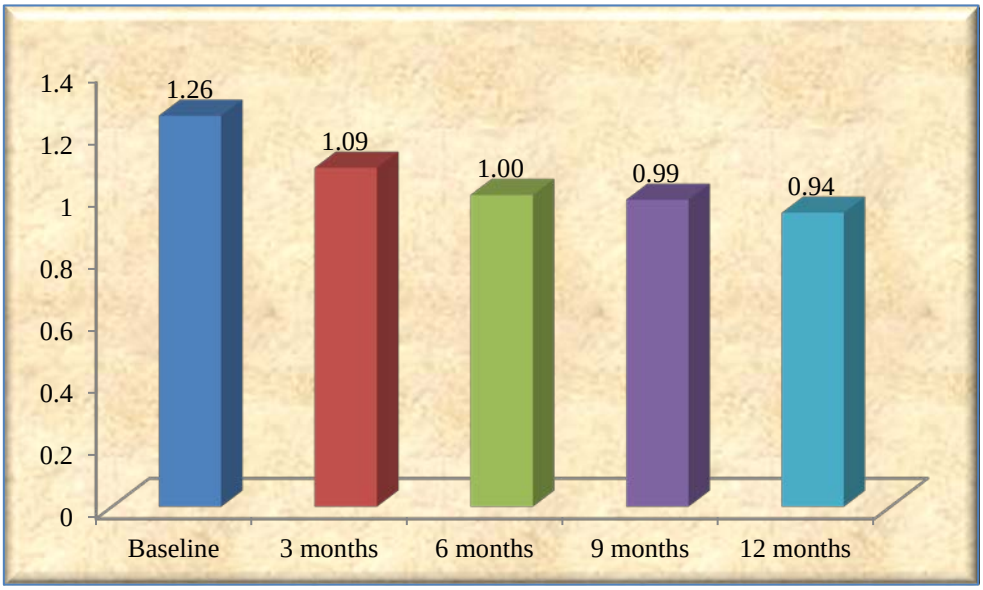
t and p values obtained from Paired t test. p value ≤ 0.05 is significant

Table 16: Describes the Comparison of the overall mean bone loss at 3 months and 12 months was 1.37 ± 0.57 mm and 1.33 ± 0.51 mm respectively. The reduction in the bone loss was not statistically significant.

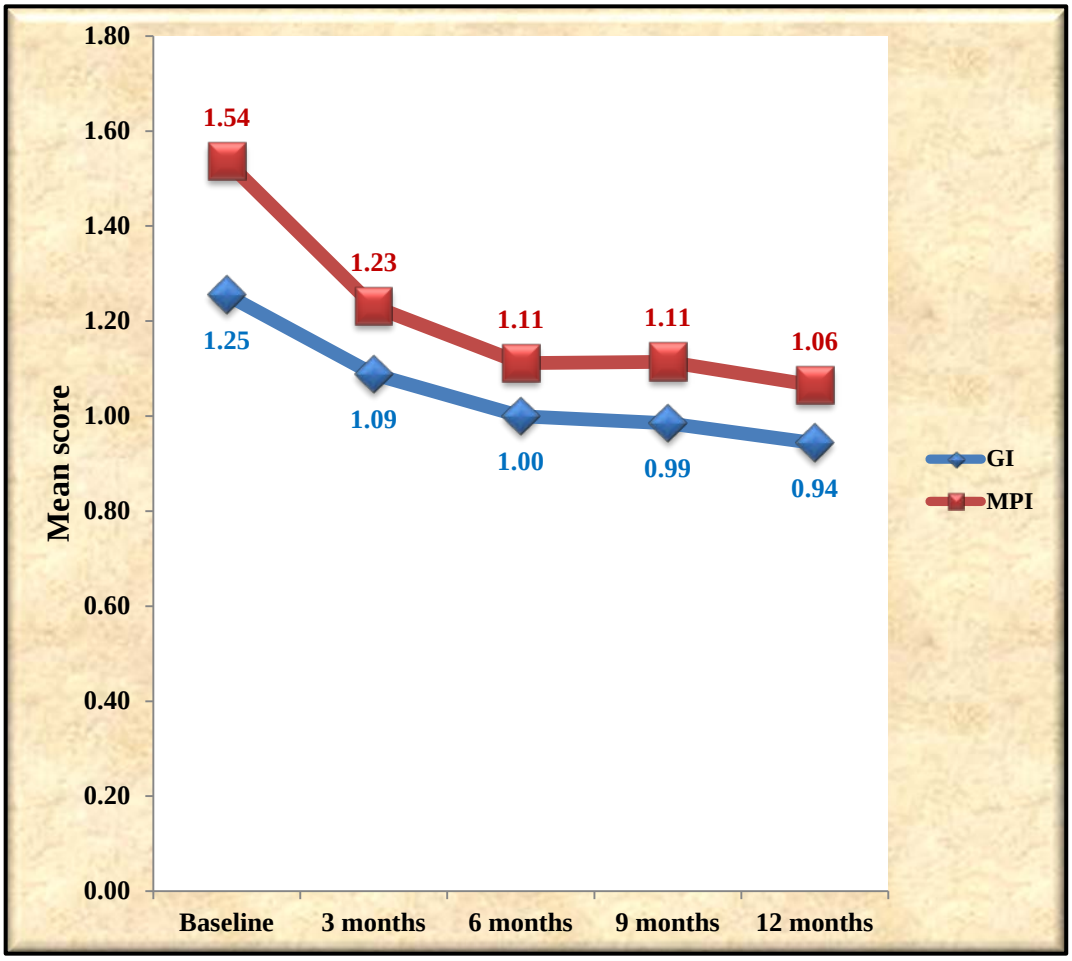
Graph: 2 Mean MPI scores across timeline



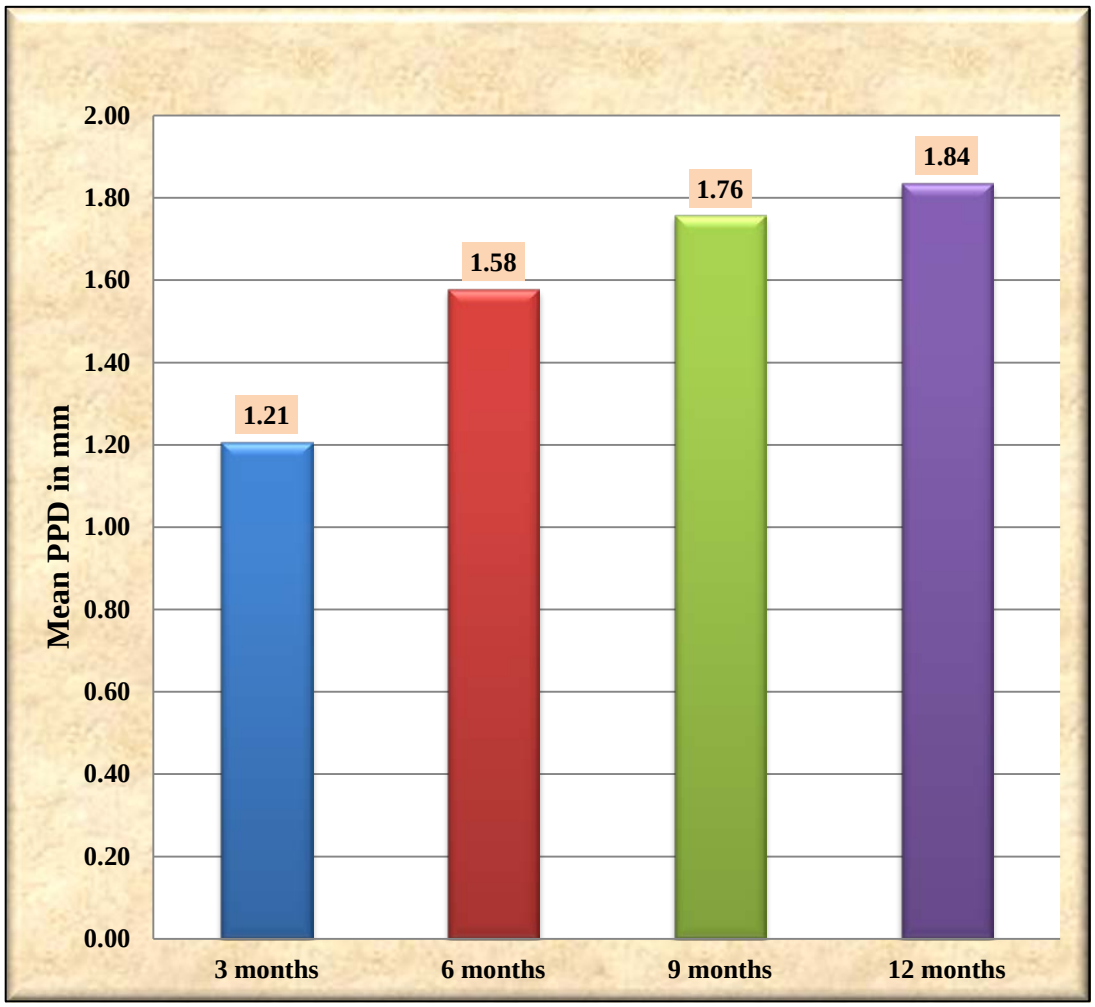
Graph: 3 Mean GI scores across time line



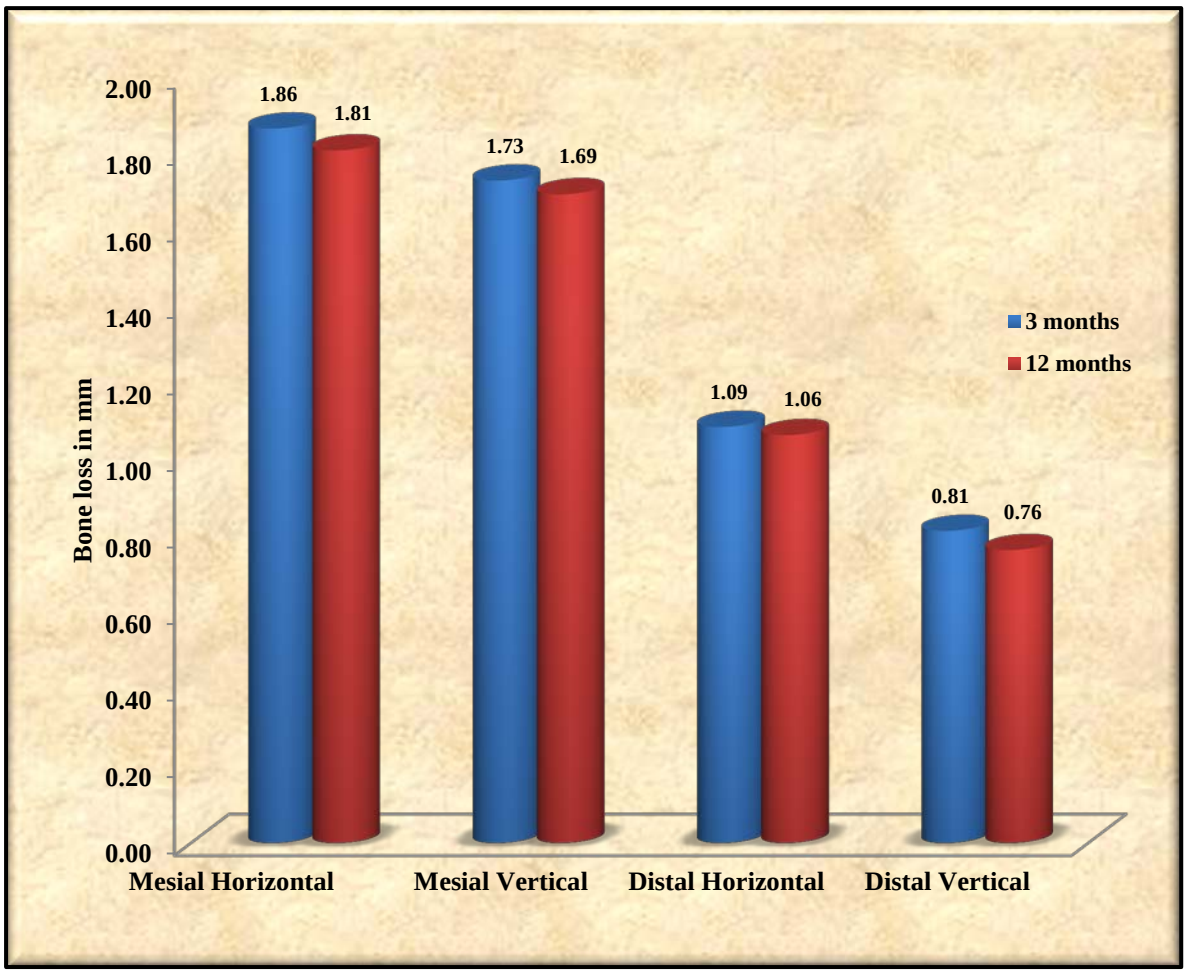
Graph: 4 Mean GI and MPI scores across the time period



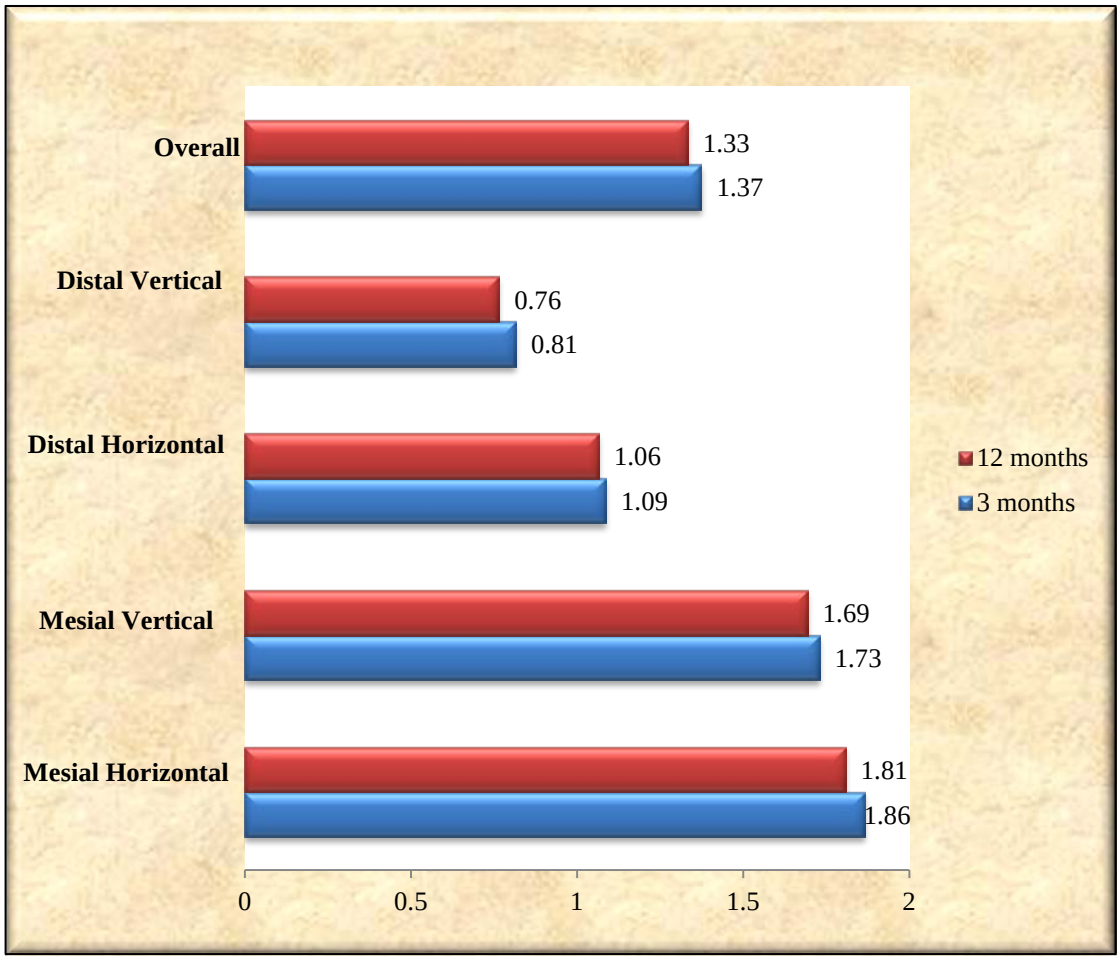
Graph: 5 Mean PPD (in mm) across the time line



Graph: 6 Mean bone loss at various sites



Graph: 7 Mean bone loss (in mm) at 3 and 12 months



DISCUSSION

Implants are broadly used for oral rehabilitation in patients who are partially or completely edentulous. Rehabilitation of severely resorbed jaws with dental implants remains a surgical and prosthetic challenge for clinicians[55]. Several advanced surgical techniques have been developed over the years to restore bone volume, allowing the placement of dental implants and improving aesthetic outcomes. The same surgical techniques have also been applied to improve crown-to-implant ratios, to allow the placement of longer implants and to optimize the positioning of implants for adequate load distribution. However, the latter indications remain controversial, and the increased treatment time, cost and risk of complications should be analyzed in line with the expected benefits.

Sinus lift elevation, guided bone regeneration, onlay bone grafting, distraction osteogenesis and displacement of the inferior alveolar nerve were developed and applied for the management of reduced alveolar bone height. Complex surgical techniques are often associated with complications [56]. Complications may occur during surgery (such as bleeding , perforation of the Schneiderian membrane or nerve injury) or postoperatively (including transiently or permanently altered mandibular sensation [55], graft and/or membrane exposure , infections [57] and increased peri-implant bone loss [57]. Even when the risk for complications is limited, advanced surgical techniques may be contraindicated in some patients for medical or anatomic reasons. As an alternative to complex surgeries (those performed to allow the placement of longer implants or for biomechanical reasons), the use of dental implants with reduced length should be considered. Along with their simplicity, short-length implants allow for less expensive and faster treatment with reduced morbidity [58, 59].

Exact definition of a short-length implant according to **Strieze & Reichart** [60], an implant of ≤11 mm is considered as short, whereas **Tawil & Younan** [61] stated that an implant must be

≤10 mm to be regarded as short. In one recent systematic review [62] and in one recent meta-analysis [63], all implants of <10 mm were defined as short implants. For the purposes of this review, a short implant will be defined as an implant with a designed intrabony length of ≤8 mm [64] and an extra-short implant as a device with a designed intrabony length of ≤5 mm. High short-implant survival rates may be obtained using a surgical bone preparation adapted to the patient's bone quality and the implant design in order to reach sufficient initial primary stability. Moreover, a micro-rough implant surface should be selected to improve peri-implant bone growth, bone-to-implant contact and bone anchorage, thus reducing the time between mechanical primary stability and biological secondary stability.

Since then many types of implants have evolved and various modifications in its design have been made to achieve better osseointegration for its long term stability[65]. The preservation of the crestal bone and soft tissue around implants is an important factor for implant success both functionally and esthetically [66, 67, 68].

Radiographs have an important role for determination of bone quality, quantity, implant position, orientation and osseointegration. The conventional radiographs are more prone to distortion in a short period, which limits its value in determining the actual quantity and quality of bone. Therefore CBCT of the edentulous area was taken pre operatively for analysis of the quantity and quality of bone three dimensionally and also to evaluate the bone changes on subsequent follow up visit.

The current study was conducted with the aim to determine, clinically assess and compare the Peri implant marginal bone level in single crowns supported short dental implants for a period of 1 year at regular 3 months time interval.14 subjects in age range of 18-55 years, with atleast one missing maxillary or mandibular posterior tooth were selected and received 14 Short dental implants. Clinical parameters namely the modified plaque index, gingival

index, probing depth, implant mobility scale were recorded. The radiographic parameter, bone loss was measured at 4 sites namely mesial horizontal, mesial vertical, distal horizontal, distal vertical by using CBCT. All the parameters were recorded before and after implant placement and at 3 months interval till one year. CBCT analysis will be done at (Baseline, 3 months (the time of crown placement), 9 months (after crown placement) to assess the peri-implant marginal bone level changes around implants.

In the present study, the mean modified plaque index score was 1.54 ± 0.31 at baseline and 1.06 ± 0.44 at 12 months. The mean gingival index score was 1.26 ± 0.47 at baseline and 0.94 ± 0.40 at 12 months. These parameters revealed that the oral hygiene status was satisfactory and the values were at low levels during the entire study, since the patient's also maintained good oral hygiene.

The mean probing depth was 1.21 ± 0.27 at 3 months and 1.84 ± 0.26 mm at 12 months. It was reported by **De Angelo et al** in **2007** that probing depth was used as the defining clinical parameter for the determination of soft tissue maturity[69]. Probing depth was less than 2mm during the entire study at various intervals. The mean probing depth showed statistically significant difference across various time periods.

According to our results, the mean modified plaque index, gingival index and probing depth for full mouth and implant, decreased from baseline, to 3 months, 6 months, 9 months and 12 months.

Absence of mobility is an important criterion for success of implant therapy. Clinically visible mobility of an implant after an appropriate healing period indicates failure to achieve osseointegration [70].

All the implants evaluated in our study at 3 months, 6 months, 9 months and 12 months did not show any amount of mobility. All the implants, at all stages were grouped into Grade 0 mobility. This is in accordance to the studies[87] conducted by researchers.

Rossi et al 2010[38] implicated implant has generally been designated as "short" when its length was ≤10 mm. Recent reviews have clearly documented that short implants may have similar outcomes compared to longer implants **Annibali et al 2012**[38]**.**

Originally, a mean crestal bone loss of ≥1.5 mm after the first year of function and a ≥0.2 mm loss per year afterwards, were considered as threshold values to determine implant success reported by **Albrektsson et al 1986** [39].

Mericske-Stern et al 2001[34] concluded the study showing a high cumulative survival rate of short implants > 8 mm supporting single crowns after 10 years was 98.3% and 5 years was 98.7%. This result is in agreement with the long-term observations reporting high survival rates on conventional implants with SLA or other moderately rough surfaces when supporting single-crown prostheses. The similar result is achieved in the present study by use of short implant modified with SLA surface.

Most of the systematic review studies reported no statistically significant differences between groups regarding MBL. On the contrary, four studies found statistically significant differences between groups. However, these differences ranged only from 0.02 to 0.32 mm[43].

In the present study mesial vertical and mesial horizontal bone loss is compared with distal vertical and distal horizontal bone loss were found to be reduced from 3 months to 12 months after loading short dental implants. These results found to be in correlation with the 3 year study conducted by **Sahrmann et al in 2016**[43] provided results that rising degree of mineralization in the bone's biological response is supposed to get hampered. Investigation of

this study proved with an obviously pronounced corticalization of the peri-implant bone, slight marginal bone loss with absence of bleeding on probing and deepened probing pocket depth.

Azpur GM et al 2016 proved that non splinted, sandblasted acid-etched surface with platform switched short dental implants success rate 1 year after loading was 100%. Sand blasting may contribute to better osseous integration, and formation of rapid contact between bone and implant was found to be greater. The characteristics of the surface may influence the survival rate of short dental implants[40].

Pistilli et al 2013 strongly proved in his recently published study using a similar design, a mean MBL of 1.02 ± 0.06 mm was shown for short implants placed in the posterior maxilla after 1 year of function. Similar results also seen in the present study prove that the radiological parameters such as the mean bone loss at the mesial horizontal site was 1.86 ± 0.32 mm, mesial vertical site was 1.73 ± 0.34 mm, distal horizontal site was 1.09 ± 0.45 mm, distal vertical site was 0.81 ± 0.38 mm at 3 months . The mean bone loss at the mesial horizontal site was 1.81 ± 0.19 mm, mesial vertical site was 1.69 ± 0.27 mm, distal horizontal site was 1.06 ± 0.33 mm, and distal vertical site was 0.76 ± 0.29 mm at 12 months. The comparison of bone loss between 3 and 12 months at various sites (mesial horizontal, mesial vertical, distal horizontal, distal vertical) was done. The overall mean bone loss at 3 months was found to be 1.37 ± 0.57 mm. The overall mean bone loss at 12 months was found to be 1.33 ± 0.51 mm. The Comparison of the overall mean bone loss at 3 months and 12 months was 1.37 ± 0.57 mm and 1.33 ± 0.51 mm respectively[39].

On comparing the means, the difference between the means was not found to be statistically significant. It indicates that the bone loss was minimal. All these differences were

statistically analysed by paired ‘t’ test and p value was obtained as 0.000 ($p < 0.05$) which was found to be statistically significant, thereby validating our hypothesis.

Result of the present study remains reliable for a short term comparison. Further studies with a longer follow up period are necessary to evaluate the performance of short implants and confirm their clinical reliability in being useful clinical substitutes for longer implants.

With the limitation of the study, it was concluded that the characteristics of the implant surface may influence the survival rate of short dental implants with minimal peri implant marginal bone loss.

SUMMARY AND CONCLUSION

Present study was conducted to evaluate the peri-implant marginal bone level in single crowns supported short dental implants. 14 subjects in age range of 18-55 years, with at least one missing maxillary / mandibular posterior tooth were selected and received 14 Short dental implants. Clinical parameters namely the modified plaque index, gingival index, probing depth, implant mobility scale were recorded. The radiographic parameter, bone loss was measured at 4 sites namely mesial horizontal, mesial vertical, distal horizontal and distal vertical by using CBCT. All the parameters were recorded before and after implant placement and at 3 months interval till one year. CBCT analysis will be done at baseline, 3 months (at the time of crown placement), 9 months (after crown placement) to assess the peri-implant marginal bone level changes around implants.

From the results of the present study, it was found that clinical parameters showed statistically significant differences ($p<0.05$) at baseline, 3 months, 6 months, 9 months and 12 months after implant placement. The peri-implant marginal bone loss measured at baseline, 3 months, and 12 months after implant placement showed minimal bone loss which was statistically significant.

With the limitation of the study, it was concluded that the characteristics of the implant surface may influence the survival rate of short dental implants with minimal peri-implant marginal bone loss.

BIBLIOGRAPHY

1. Wowern N,Gotfredsen K.Implant-supported overdentures,a prevention of bone loss in edentulous mandibles.Clin Oral implants Res 2001;12(1):19-25.

2. Albrektesson T, Zarb G, Worthington P, Eriksson AR. The Long – Term Efficacy of Currently Used Dental Implants : A Review and Proposed Criteria of Success. Journal Of Medical Insight. 1986 Jan; 11-25.

3. Ragnar A, Eriksson B, Lekholm U, Branemark PI, Torsten J, A Long-Term Follow-up Study of Osseointegrated Implants in the Treatment of Totally Edentulous Jaws. Int J Oral Maxillofac Implants. 1990 Winter; 5(4): 347-59.

4. Khalifa AK, Wada M, Ikebe K, Maeda Y. To what extent residual alveolar ridge can be preserved by implant? A systematic review. Int J Implant Dent. 2016 Dec; 2: 22.

5. Albrektsson T, Johansson C, Sennerby L. Biological Aspects Of Implant Dentistry: Osseointegration. Periodontol 2000 1994; 58-73.

6. Arvidson K. A subsequent two-stage dental implant system and its clinical application. Periodontol 2000. 1998; 96-105.

7. Carranza FA, Takei HH, Cochran DL. Clinical diagnosis. In: Newman MG, Takei HH, Klokkevold PR, Caranza FA, editors. Caraza's clinical peridontology. 10th ed. Nodia: Saunders, Reed Elsevier India Private Limited; 2006.

8. Bruyn H, Stefanie R, Ostman PO, Cosyn J. Immediate loading in partially and completely edentulous jaws: a review of the literature with clinical guidelines. Periodontol 2000. 2014; 153-187.

9. AAID Nomenclature Committee. Glossary of implant terms. J Oral Implantol 1990; 16:57-63.

10. Adell R, Ericsson B, Lekholm U. A long term follow up study of osseointegrated implants in the treatment of totally edentulous jaws. Int J Oral Maxillofac Impl 1990; 5: 347-359.

11. Atsumi M, Park SH, Wang HL. Methods used to assess implant stability: current status. Int J Oral Maxillofac Implants. 2007; 22(5):743-54

12. Ostman PO, Hellman M, Wendelhag I, Sennerby L. Resonance Frequency Analysis Measurements of Implants at Placement Surgery. Int J Prosthodont. 2006 Jan-Feb;19(1):77-83.

13. Mombelli A, Lang NP. Clinical parameters for the evaluation of dental implants. Periodontol 2000. 1994; 81-86.

14. Strub JR, Jurdzik BA, Tuna T. Prognosis of immediately loaded implants and their restorations: a systematic literature review. J Oral Rehabil. 2012 Sep;39(9):704-17.

15. Palmer RM. Dental implants: Introduction to dental implant. British dental journal. 1999 Aug;1-7.

16. Koodaryan R, Hafezeqoran A. Evaluation of Implant Collar Surfaces for Marginal Bone Loss: A Systematic Review and Meta-Analysis. BioMed Research International. 2016 Jun;1-10.

17. Annibali et al. short Dental Implants: A systematic review. J. Dent. Res. *2012 91(1) 25-32.*

18. Grishmi N, Deepti G. Platform Switching- A Paradigm Shift In Implant Dentistry. International Journal of Advanced Research. 2016 Jan; 215-218.

19. Lazzara RJ, Porter SS. Platform Switching: A New Concept in Implant Dentistry for Controlling Postrestorative Crestal Bone Levels. Int J Periodontics Restorative Dent. 2006 Feb;26(1):9-17.

20. Mandelaris GA, Neiva R, Chambrone L. Cone-Beam Computed Tomography and Interdisciplinary Dentofacial Therapy: An American Academy of Periodontology Best Evidence Review Focusing on Risk Assessment of the Dentoalveolar Bone Changes Influenced by Tooth Movement. J Of Periodontol.2017; 88:960-977.

21. Angelopoulos C, Aghaloo T. Cone Beam Computed Tomography for the Implant Patient. Dental Clinics of North America. 2011 Jan; 55:141-158.

22. Pinheiro LR, Scarfe WC, Oliveira MA, Gaia BF, Gonzalez AR, Cavalcanti MG. Effect of Cone-Beam Computed Tomography Field of View and Acquisition Frame on the Detection of Chemically Simulated Peri-Implant Bone Loss In Vitro. J Of Periodontol. 2015 Oct; 86: 1159-1165.

23. L Ritter,M C Elger, D Rothamel. Accuracy of peri-implant bone evaluation using cone beam CT, digital intra-oral radiographs and histology Dentomaxillofac Radiol. 2014;43(6):20130088.

24. Driskell TD:History of implants,CDA J 15:16-25,1987.

25. Ring ME:A thousand years of implants:a definitive history-part 1,Compend Contin Educ Dent 16:1060,1062,1064 passim,1995.

26. Branemark PI, Zarb G, Albrektsson T:Tissue-Integrated Prosthesis:Osseointegration in Clinical Dentistry.Chicago, Quintessence Publishing, 1985.

27. Branemark PI,Adell R, Breine U, Hansson BO,Lindstrom J,Ohlsson A:Intra-osseous anchorage of dental prostheses.I. Experimental studies,Scand J PlasT Reconstr Surg 3:81-100,1969.

28. McClarence E:Close to the Edge;Branemark and the development of Osseointegration.London, Quintessence Publishing 2003.

29. Ahmed A, Shah S, Kim S.PD071: The outcome of short dental implants: a retrospective study.J Clin Periodontal 2018;vol 45:66-66.

30. Pommer B, Frantal S, Willer J, Posch M, Watzek G, Tepper G. Impact of dental implant length on early failure rates: a meta-analysis of observational studies. J Clin Periodontol. 2011 *Sep;*38*(9):*856-*63.*

31. Telleman G, Raghoebar GM, Vissink A, Meijer HJA. Impact of platform switching on interproximal bone levels around short implants in the posterior region; 1-year results from a randomized clinical trial. J Clin Periodontol 2012 ; 39: 688–697.

32**.** Annibali S, Cristali MP, Dell Aquila D, Bignozzi I,Short dental implants:A systematic review. J Dent Res 2012;91(1):25-32.

33. Monje A, Fu JH, Chan HL, Suarez F. Do implant length and width matter for short dental implants (<10 mm)? A meta-analysis of prospective studies. J Periodontol. 2013 Dec;84(12):1783-91.

34. . Lai HC, Si MS, Zhuang LF, Shen H, Liu YL, Wismeijer D: .Long-term outcomes of short dental implants supporting single crowns in posterior region: a clinical retrospective study of 5-10 years.Clin Oral Implants Res. 2013 Feb;24(2):230-7.

35 . Monje A, Suarez F, Galindo-Moreno P, García-Nogales A. A systematic review on marginal bone loss around short dental implants (<10 mm) for implant-supported fixed prostheses. Clin Oral Implants Res. 2014 Oct;25(10):1119-24.

36. Thoma DS, Haas R, Tutak M, Garcia A, Schincaglia GP**:**Randomized controlled multicenter study comparing short dental implants (6mm) versus longer dental implants (11-15mm) in combination with sinus floor elevation procedures. Part 1: demographics and patient-reported outcomes at 1 year of loading. J Clin Periodontol. 2015 Jan;42(1):72-80.

37. Nisand D, Renouard F: Short implant in limited bone volume. Periodontol 2000, Vol. 66, 2014; 72–96.

38. Rossi F, Lang NP, Ricci E ,Ferraioli L,Marchetti C,Botticelli D : Early loading of 6-mm-short implants with a moderately rough surface supporting single crowns – a prospective 5-year cohort study. Clin Oral *Implants* Res. 2015 ;26(4):471-477.

39. Schincaglia GP, Thoma DS, Haas R, Tutak M. Randomized controlled multicenter study comparing short dental implants (6 mm) versus longer dental implants (11–15 mm) in combination with sinus floor elevation procedures. Part 2: clinical and radiographic outcomes at 1 year of loading. J Clin Periodontol 2015; 42: 1042–1051.

40. Medoza-azpur G, Lau.M, Erick Valdivia E ,Jorge Rrojas J. Assessement of marginal peri implant bone level short length implants compared with standard implants supporting single crowns in clinical trials.Int J Periodontics Restorative Dent 2016;36:791-795.

41. Palacios J,Garcia J,Carames J,Quirynen M .Short implants versus bone grafting and standard-length implants placement:a systematic review.Clinc Oral Invest. 2016 Jan;22(1):69-80.

42. Annunziata M,Guida L,Esposito U, Sirignano M. Short vs standard- length implants supporting fixed mandibular full- arch prostheses: 12- month report from a multicenter RCT J Clin Periodontol 2017.

43. Sahrmann P, Schoen P, Naenni N, Jung R, Attin T, Schmidlin PR. Peri-implant Bone Density around Implants of Different Lengths: A 3-year Follow-up of a Randomized Clinical Trial. J Clin Periodontoal. 2017 Jul;44(7):762-768.

44. Papaspyridakos P, De Souza A, Vazouras K, Gholami H. Survival rates of short dental implants (≤6 mm) compared with implants longer than 6 mm in posterior jaw areas: A meta-analysis. Clin Oral Implants Res. 2018 Oct;29 Suppl 16:8-20.

45. Gurlek O,Buduneli N,Kaval ME,Nizam N.Extra short implants in the prosthetic rehabilitation of atrophic maxilla:a prospective randomized clinical study.J Clin Periodontal 2018-PD057.

46. S.J.Rocha SJ,Wagner W,Wiltfang J,Guerra F,Moergel M.Platform switching versus platform matching:5-year results from a prospective randomized-controlled multicenter study.J Clin Periodontal.2018-PR655

47. Ahmed A, Shah S, Kim.The outcome of short dental implants:retrospective study. J Indian Prosthodont Soc. 2018 Jul-Sep; 18(3): 201–211.

48. Thoma DS, Haas R, Sporniak-Tutak K, Garcia A, Taylor TD, Hämmerle CHF. Randomized controlled multicentre study comparing short dental implants (6 mm) versus longer dental implants (11– 15 mm) in combination with sinus floor elevation procedures: 5- Year data. J Clin Periodontol. 2018 Dec;45(12):1465-1474.

49. A Ravidà, IC Wang, S Barootchi, H Askar.Meta-analysis of randomized clinical trials comparing clinical and patient-reported outcomes between extra-short (≤ 6 mm) and longer (≥ 10 mm) implants. J of clinc Periodontol 2019 Jan;46(1):118-142.

50. Ethical Principles for Medical Research Involving Human Subjects. World Medical Association Declaration Of Helsinki. 2008 Oct;1-5.

51. Mombelli A, van Oosten MAC, Schurch E. The microbiota associated with successful or failing osseointegrated titanium implants. Oral Microbiol Immunol 1987; 2: 145-151.

52. Apse P, Zarb GA, Schmitt A, Lewis DW. The longitudinal effectiveness of osseointegrated dental implants. The Toronto Study. Peri implant mucosal response. Int J Periodont Restorative Dent 1991; 11: 95 -111.

53. Rams TE, Slots J. Comparison of two pressure sensitive periodontal probes and a manual periodontal probe in shallow and deep pockets. Int J Periodont Restorative Dent 1993; 13: 521-529.

54. Misch CE. Implant success or failure: clinical assessment in implant dentistry. In Misch CE, editor: Contemporary implant dentistry pp 29-42, St Louis, 1993, Mosby.

55.Chaushu G,Taicher S,Halamish-Shani T,Givol N,Medico legal aspects of altered sensation following implant placement in the mandible.Int J Oral Maxillofac Implants 2002;17:413-415.

56. Esposito M, Grusovin MG, Felice P, Karatzopoulos G, Worthington HV, Coulthard P. The efficacy of horizontal and vertical bone augmentation procedures for dental implants – a Cochrane systematic review. Eur J Oral Implantol 2009; 2: 167–184.

57. Verardi S, Simion M. Management of the exposure of e-PTFE membranes in guided bone regeneration. Pract Proced Aesthet Dent 2007; 19: 111–117.

58. Esposito M, Pellegrino G, Pistilli R, Felice P. Rehabilitation of posterior atrophic edentulous jaws: prostheses supported by 5 mm short implants or by longer implants in augmented bone? One-year results from a pilot randomised clinical trial Eur J Oral Implantol 2011; 4: 21 –30.

59. Esposito M, Cannizarro G, Soardi E, Pellegrino G, Pistilli R, Felice P. A 3-year post-loading report of a randomised controlled trial on the rehabilitation of posterior atrophic mandibles: short implants or longer implants in vertically augmented bone? Eur J Oral Implantol 2011; 4: 301–311.

60. Strietzel FP, Reichart PA. Oral rehabilitation using Camlog screw-cylinder implants with a particle-blasted and acidetched microstructured surface Results from a prospective study with special consideration of short implants. Clinical evaluation of short, machined-surface implants followed for 12 to 92 months. Clin Oral Implants Res 2007; 18: 591–600.

61. Tawil G, Younan R. Clinical evaluation of short, machined-surface implants followed for 12 to 92 months. Int J Oral Maxillofac Implants 2003; 18: 894–901.

62. Telleman G, Raghoebar GM, Vissink A, den Hartog L, Huddleston Slater JJ, Meijer HJ. A systematic review of the prognosis of short (<10 mm) dental implants placed in the partially edentulous patient. J Clin Periodontol 2011; 38: 667–676.

63. Pommer B, Frantal S, Willer J, Posch M, Watzek G, Tepper G. Impact of dental implant length on early failure rates: a meta-analysis of observational studies. J Clin Periodontol 2011; 38: 856–863.

64. Renouard F, Nisand D. Impact of implant length and diameter on survival rates. Clin Oral Implants Res 2006; 17 (Suppl 2): 35–51.

65. Tonetti MS, Schmid J. Pathogenesis of implant failures. Periodontol 2000. 1994; 127-138.

66. Esfahrood ZR, Mahdi K, Gholamin P. Biologic Width around Dental Implants: An Updated Review. Journal of Dental Materials and Techniques. 2016; 68-81.

67. Valles C, Xavier RC, Nart J, Santos A. Influence of Implant Neck Surface and Placement Depth on Crestal Bone Changes Around Platform – Switched Implants : A Clinical and Radiographic Study in Dogs. J Of Periodontol. 2017; 1200-1210.

68. Salamanca E, Jerry C, Tsai CY. Dental Implant Surrounding Marginal Bone Level Evaluation : Platform Switching Versus Platform Matching - One- Year Retrospective Study. BioMed Research International. 2017; 1-9.

69. Papaspyridakos P, De Souza A, Vazouras K, Gholami H. Survival rates of short dental implants (≤6 mm) compared with implants longer than 6 mm in posterior jaw areas: A meta-analysis. Clin Oral Implants Res. 2018 Oct;29 Suppl 16:8-20.

70. Kan JYK, Rungcharassaeng K, Lozada J. Immediate placement and provisionalization of maxillary anterior single implants.1-year prospective study. Int J Oral Maxillofac Impl 2003; 18: 31-39.

`

ANNEXURE 1

INSTITUTIONAL ETHICAL COMMITTEE

Best Dental Science College and Hospital
Ultra Nagar, Madurai - 625 104.
RECOGNIZED BY DENTAL COUNCIL OF INDIA, NEW DELHI
AFFLIATED TO THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI)

IRB/IEC Reference No: 2018-STU-BrII-RPG-04

Project title: Assessment of Peri-Impant Marginal Bone Level in Single Crowns Supported by Short Dental Implants- A CBCT Study.

Principal Investigator: Dr. R.P.Gomathi, PG student

Review: New/Revised/Expedited

Date of Review: 23/02/2018

Date of previous review, if revised application:

Decision of the IEC/IRB:

- Approval to conduct the study is being given

Signature of the Principal

PRINCIPAL
BEST DENTAL SCIENCE COLLEGE
MADURAI-625104

NB:

Inform IRB/IEC immediately in case of any issue(s)/adverse events

Inform IRB/IEC in case of any change of study procedure, site and investigator

This permission is only for the period mentioned above

Annual report to be submitted to IEC/IRB

Members of IEC/IRB have right to monitor the trail with prior intimation

ANNEXURE 2

DEPARTMENT OF PERIODONTOLOGY

BEST DENTAL SCIENCE COLLEGE & HOSPITAL, MADURAI

DR.MGR MEDICAL UNIVERSITY

INFORMED CONSENT FORM

Name : Mr/Ms/Mrs	**OP.No :**
Address :	**SEX : Male/Female**
	AGE : Years

I, _____, exercising my free power of choice, hereby give my consent to be included as a participant in the study.

I agree to the following :

1. I have been informed to my satisfaction about the purpose of the study and procedures.

2. I understand that the study involves questions which may sometimes be personal.

3. I agree to co-operate fully for complete examination.

4. I agree to give my blood sample for investigation.

5. I agree to report to my doctor for a regular follow up and when required for the research.

6. I have informed my doctor about all the medications that I am currently taking.

7. I hereby give permission to use my medical records for research purpose. I have been told that the investigating doctor and the institution will keep my identity confidential.

8. I understand that I have rights to withdraw myself from the study and also that the investigator has the right to exclude me from the research at any point of time.

SIGNATURE OF THE PARTICIPANT

ANNEXURE 3

ஒப்புதல் படிவம்

திரு/திருமதி/செல்வி .....

வயது ..... த/பெ. க/பெ. .....

என்ற முகவரியில் வசித்து வரும் நான் முழு சுயநினைவுடன் மனப்பூர்வமாகவும் யாருடைய தூண்டுதலின் பேரிலும் அல்லாமலும் உறுதி கூறுவது என்னவென்றால்,

1. செயல்முறையினை பற்றி எனக்கு நன்கு விளக்கப்பட்டுள்ளது. மேலும் இதில் வரும் நன்மை தீமையினை என் சுயநினைவோடு புரிந்து கொண்டேன். இதன் மூலம் என்னுடைய மனப்பூர்வமான சம்மதத்தை உறுதிப்படுத்துகிறேன்.
2. நான் நீங்கள் அழைக்கும் போது மறுபடியும் வந்து வாய் பரிசோதனைக்கு உங்களுக்கு முழு ஒத்துழைப்பு தருகிறேன்.

கையொப்பம்

இடம் : பெஸ்ட் பல் மருத்துவக்கல்லூரி மற்றும் மருத்துவமனை,
ஈறு நோய் சிகிச்சைப்பிரிவு,
மதுரை.

நாள் :

ANNEXURE 4

DEPARTMENT OF PERIODONTOLOGY AND IMPLANTOLOGY

BEST DENTAL SCIENCE COLLEGE AND HOSPITAL

DR.MGR MEDICAL UNIVERSITY

ASSESSMENT OF PERI-IMPLANT MARGINAL BONE LEVEL IN SINGLE CROWNS SUPPORTED BY SHORT DENTAL IMPLANTS – A CBCT STUDY

MAIN DISSERTATION PROFORMA

IMPLANT CASE SHEET

Demographical Information:-

Patient's O P No :	
Patient's Name :	Phone No :
Age :	Occupation :
Gender :	Marital status :
Education :	Economy :
Habits :	Address :
Date of Operation :	Date of Delivery of Crown :

History:

Medical History :

Dental History :

Clinical Examination:

Oral Hygiene:

Periodontal Condition:

State of Occlusion:

Missing Teeth:

8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**

Number of Missing Teeth:

Width of Ridge:

Inter-Maxillary Space:

Artificial Appliances:

Investigation:

CBCT ……

1. Distance From The Crest Of The Ridge :
    i. Maxillary Sinus
    ii. Nasal Floor
    iii. Inferior Alveolar Canal
2. Adjacent Teeth:
3. Condition Of Bone:

Blood Investigations (on need)

Diagnosis:

Prognosis:

Management:

Preoperative Assessment:

Type of Implant:

Site of Implant:

Number of Implant:

Length of Implant:

Width of Implant:

Operative notes:

Postoperative notes:

Follow up:

Gingival former:

Prosthetic work:

PARAMETERS	BASELINE	3MONTH	6MONTHS	9MONTHS	1 YEAR
MODIFIED PLAQUE INDEX					
GINGIVAL INDEX					
PROBING POCKET DEPTH	-				
MOBILITY SCALE	-				

CRESTAL BONE LOSS	IN CBCT
AT BASELINE(at the time of crown placement)	
AT 1 YEAR(9 months after crown placement)	

	PROPOSED DATE	REPORTED DATE
AT BASELINE		
AFTER 3 MONTHS		
AFTER 6 MONTHS		
AFTER 9 MONTHS		
AT 1 YEAR		

ANNEXURE 5

MASTER CHART

MODIFIED PLAQUE INDEX

S.NO	AGE	SEX	TOOTH	Modified Plaque Index				
				Baseline	3 Months	6 Months	9 Months	12 Months
1.	44	F	36	2	1.8	1.5	1.3	1.2
2.	47	M	36	1.8	1	1.07	0.8	0.9
3.	33	M	46	1.8	1.9	1.7	1.7	1.8
4.	47	M	16	1	1.1	1	0.9	1
5.	42	F	46	1.3	0.9	0.9	0.9	0.9
6.	29	M	46	1.8	1.9	1.8	1.7	1.4
7.	27	M	46	1.8	1.6	1.5	1.8	1.8
8.	44	F	25	1.1	0.9	0.7	0.7	0.5
9.	23	F	36	1.1	1.03	1.03	1.3	1.4
10.	42	M	46	1.4	1	1.06	0.8	0.8
11.	23	F	36	1.6	1.4	1.2	1.6	1.4
12.	56	M	46	1.6	0.9	0.7	0.7	0.6
13.	56	M	17	1.6	0.9	0.7	0.7	0.6
14.	56	M	27	1.6	0.9	0.7	0.7	0.6

GINGIVAL INDEX

S.NO	AGE	SEX	TOOTH	GINGIVAL INDEX				
				Baseline	3 Months	6 Months	9 Months	12 Months
1.	44	F	36	2	1.8	1.2	1.03	0.9
2.	47	M	36	1.6	1	0.8	0.8	0.8
3.	33	M	46	1.8	1.7	1.5	1.6	1.5
4.	47	M	16	1	1.1	0.9	1	0.9
5.	42	F	46	1.27	0.9	0.9	0.9	0.9
6.	29	M	46	1.9	1.8	1.9	1.7	1.7
7.	27	M	46	1.8	1.5	1.7	1.5	1.6
8.	44	F	25	1	0.8	0.6	0.5	0.5
9.	23	F	36	0.7	1.03	1.1	1.16	1.2
10.	42	M	46	0.7	0.7	0.8	0.6	0.6
11.	23	F	36	0.8	0.8	0.8	0.9	0.8
12.	56	M	46	1	0.7	0.6	0.7	0.6
13.	56	M	17	1	0.7	0.6	0.7	0.6
14.	56	M	27	1	0.7	0.6	0.7	0.6

PROBING DEPTH

S.NO	AGE	SEX	TOOTH	PROBING DEPTH			
				3 Months	6 Months	9 Months	12 Months
1.	44	F	36	1	1.2	1.5	1.5
2.	47	M	36	1.5	1.5	1.7	2
3.	33	M	46	1	2	2	2
4.	47	M	16	1.7	2	2	2.2
5.	42	F	46	1.5	1.7	1.7	2
6.	29	M	46	1	1.5	1.7	2
7.	27	M	46	1.5	2	2	2
8.	44	F	25	1	1.5	1.5	1.5
9.	23	F	36	1	2	2	2
10.	42	M	46	1.5	1.5	2	2
11.	23	F	36	1.2	1.7	2	2
12.	56	M	46	1	1	1.5	1.5
13.	56	M	17	1	1	1.5	1.5
14.	56	M	27	1	1.5	1.5	1.5

MESIAL HORIZONTAL & MESIAL VERTICAL BONE LOSS

S.NO	AGE	SEX	TOOTH	Mesial Horizontal Bone Loss		Mesial Vertical Bone Loss	
				3 Months	12 Months	3 Months	12 Months
1.	44	F	36	1.2	1.7	1.7	1.5
2.	47	M	36	1.8	1.6	2.1	1.8
3.	33	M	46	2.2	1.9	2	1.8
4.	47	M	16	1.6	1.7	1.2	1.4
5.	42	F	46	2.2	2	2.1	1.9
6.	29	M	46	2.1	1.8	1.7	1.9
7.	27	M	46	2.3	1.5	1.9	2.1
8.	44	F	25	1.6	2	1.8	1.2
9.	23	F	36	1.9	1.7	1.7	1.5
10.	42	M	46	1.8	2.1	2	1.9
11.	23	F	36	2.3	2	2.1	1.8
12.	56	M	46	1.8	1.5	1.5	1.5
13.	56	M	17	1.6	1.9	1.2	2
14.	56	M	27	1.7	1.9	1.2	1.4

DISTAL HORIZONTAL & DISTAL VERTICAL BONE LOSS

S.NO	AGE	SEX	TOOTH	Distal Horizontal Bone Loss		Distal Vertical Bone Loss	
				3 Months	12 Months	3 Months	12 Months
1.	44	F	36	0.9	0.9	1.3	1.1
2.	47	M	36	0.7	0.7	0.2	0.2
3.	33	M	46	1.2	1.1	1.1	0.9
4.	47	M	16	0.4	0.5	0.3	0.4
5.	42	F	46	1.3	1.2	0.7	0.7
6.	29	M	46	1.7	1.1	0.5	0.6
7.	27	M	46	1.2	1.3	0.2	0.4
8.	44	F	25	0.4	0.9	0.9	1
9.	23	F	36	1.5	1.4	1	0.8
10.	42	M	46	1.9	1.8	1.1	1.2
11.	23	F	36	1.3	1.1	0.8	0.6
12.	56	M	46	1	0.7	1.1	1
13.	56	M	17	0.8	0.9	1.2	0.9
14.	56	M	27	0.9	1.3	1	0.9