EFFICACY OF RIDGE SPLIT TECHNIQUE IN HORIZONTAL ALVEOLAR RIDGE AUGMENTATION FOR IMPLANT PLACEMENT.

Dissertation

Submitted to

BABU BANARASI DAS UNIVERSITY

LUCKNOW, UTTAR PRADESH.

In the partial fulfillment of the requirements for the degree

Of

MASTER OF DENTAL SURGERY

In

ORAL AND MAXILLOFACIAL SURGERY

By

Dr. Shahanika

Under the guidance of

Dr. Hemant Gupta

Professor and Head

Department of Oral and Maxillofacial Surgery

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW

(Faculty of Babu Banarasi Das University)

BATCH: 2020-2023 **Enrollment No. 1200323004**

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"EFFICACY OF RIDGE SPLIT TECHNIQUE IN HORIZONTAL ALVEOLAR RIDGE AUGMENTATION FOR IMPLANT PLACEMENT."** is a bonafide and genuine research work carried out by me under the guidance of **Dr. Hemant Gupta**, Professor and Head, Department of Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Date: 15/2/23

Place: BBDCODS Lucknow

Shahanika

Dr. Shahanika

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"EFFICACY OF RIDGE SPLIT TECHNIQUE IN HORIZONTAL ALVEOLAR RIDGE AUGMENTATION FOR IMPLANT PLACEMENT."** is a bonafide work done by **Dr. Shahanika** under my direct supervision and guidance in partial fulfilment of the requirement for the degree of MDS in Oral and Maxillofacial Surgery.

Date 15/2/23

Dr. Hemant Gupta
Professor & Head
Department of Oral & Maxillofacial Surgery
BBDCODS, BBDU
Lucknow

CERTIFICATE BY THE CO-GUIDE

This is to certify that the dissertation entitled **"EFFICACY OF RIDGE SPLIT TECHNIQUE IN HORIZONTAL ALVEOLAR RIDGE AUGMENTATION FOR IMPLANT PLACEMENT."** is a bonafide work done by **Dr. Shahanika** under my direct supervision and guidance in partial fulfilment of the requirement for the degree of MDS in Oral and Maxillofacial Surgery.

Date: 15/2/23

Dr. Ankit Gangwar
Reader
Department of Oral & Maxillofacial Surgery
BBDCODS,BBDU
Lucknow

ENDORSEMENT BY THE HOD/ HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"EFFICACY OF RIDGE SPLIT TECHNIQUE IN HORIZONTAL ALVEOLAR RIDGE AUGMENTATION FOR IMPLANT PLACEMENT"** is a bonafide work done by **Dr. Shahanika** under direct supervision and guidance of **Dr. Hemant Gupta**, Professor& Head, Department of Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Dr. Hemant Gupta
Professor & Head
Department of Oral & Maxillofacial Surgery
Babu Banarasi Das College of Dental Sciences
Babu Banarasi Das University
Lucknow(U.P)

Dr. Puneet Ahuja
Dean
Babu Banarasi Das College of Dental Sciences
Babu Banarasi Das University
Lucknow (U.P)

COPYRIGHT DECLARATION BY THE CANDIDATE

I hereby declare that the **Babu Banarasi Das University** shall have the right to preserve, use and disseminate this dissertation in print or electronic format for academic / research purpose.

Date: 15/2/23

Place: BBDCODS
Lucknow

Shahanika

Dr. Shahanika

ACKNOWLEDGEMENT

Dedicated To My Parents

(For their endless love, support and encouragement)

At the outset I wish to express my heartfelt devotion and submission at the lotus feet of ***the Almighty***, who is the wirepuller of the show of the entire creation in whose presence the entire animated and unanimated world bows low in supplication and prayers.
The most pleasant part of writing a thesis is acknowledging ones gratitude to someone special and all those who have helped in its completion.

*The words are few and the language seems feeble when heart is full of gratitude. Words cannot express my deep sense of gratitude and respect to my esteemed teacher, my guide****. Dr. Hemant Gupta, Professor & Head, Department of Oral & Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow*** *who has been a constant source of inspiration to me since the very beginning of this work. I am extremely thankful for his patient listening and the detailed discussions on various topics, which were of immense help to me. It is only because of his critical supervision, constructive, suggestive and overall encouraging sympathetic attitude that my work has acquired the present shape. I am really fortunate to work with an academician of outstanding status and the experience makes me richer for the rest of my life.*

It takes a big heart to help shape little minds… I would like to extend my sincere thanks to ***Dr. Rashmi Agarwal*** *,* ***Dr. Hemant Mehra, Reader, Department of Oral & Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences,Lucknow*** for her care, support and valuable feedback. Her encouraging words have always been a motivation.

I am deeply indebited to my co-guide***, Dr. Ankit Gangwar, Reader, Department of Oral & Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow*** for his immense help. A great visionary and kind-hearted person, he has been a constant support. His timely suggestion and encouragement at every step which has been a constant light to brighten my path in every possible way.

A very special thanks to ***Dr. Ashish Uppal, Senior Lecturer, Department of Oral & Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow*** who bestowed his constructive suggestions to further improve the manuscript. I sincerely appreciate his valuable suggestions in this venture. I would like to thank ***Dr. Ishita Shrivastava, Dr. Sobia Afreen, Senior Lecturer, Department of Oral & Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow*** for being cooperative

always. Without their cooperation this dissertation would have been lot more difficult. I am sincerely thankful to them.

I am grateful and obliged to ***Dr.Puneet Ahuja , Professor and Dean, Babu Banarasi Das College of Dental Sciences, Lucknow,*** without whose cooperation and support, this research would not have been possible.

I extend my gratitude to my super seniors ***Dr. Ashish pandey and Dr. Shiwangi yadav***. It is with great pleasure I acknowledge their role. Special thanks to my juniors ***JR-II Abhijeet, Maruf, Pallavi and JR-I jaya, shiwangi, shiwankar*** for their kind hearted helpfulness.

My gratitude also goes to my batchmates ***Dr. Piyush Raj Dharmi, Dr. Rajatava Paria*** for easing out the difficult situations by their timely advice and reminders, for making me laugh whenever I got too serious. As we started this journey together, no one can understand this journey better.

I couldn't have reached this far without my family. My mere words will never match the extent of affection I received from them. I express my love and warmest gratitude to my parents ***Mr. Ramesh Chandra Yadav and late Mrs. Prarthana Yadav*** and my sister ***Dr. Nivedita Yadav*** . I thank them all for their understanding, constant support, selfless love and encouragement that they have always provided me. They stood by me through all my ups and downs. I dedicate this piece of work to them.

A big thankyou to my friends ***Dr. Arti, Dr. Bhhibhuti, Dr. Sadia*** for their constant support.

It is my duty to express my sincere thanks to the non-teaching staff, ***Mr. Nankan, Mr. Haider.***

I am thankful to all those, who helped me and provided their cooperation that made me complete my work. My apologies to those I have unintentionally omitted.

Last but not the least my sincere thanks to ***my patients*** who were the foundation of the study.

Dr. Shahanika

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF FIGURES

LIST OF ANNEXURES

LIST OF ABBREVIATIONS

ASA	:	American Society of Anesthesiologists
CBCT	:	Cone Beam Computed Tomography
OPG	:	Orthopentomograph
CT	:	Computed Tomography
GBR	:	Guided bone regeneration
ISQ	:	Implant Stability Quotient
LRA	:	Lateral Ridge Expansion.
MRE	:	Motorized Ridge Expanders.
SRSP	:	Segmental Ridge Split Procedure
SD	:	Standard Deviation

ABSTRACT

AIM:

The aim of this study is to assess the efficacy of the ridge split technique in horizontal bone augmentation in Knife ridges for implant placement.

OBJETIVES:

The objectives of this study are: -

1) To evaluate width of the alveolar ridge gained with ridge split
2) To evaluate the primary and secondary implant stability.
3) To evaluate the total crestal bone loss.
4) To evaluate any complication related to ridge split technique procedure.

MATERIALS AND METHOD:

Ten patients with atrophic alveolar ridges requiring ridge expansion and simultaneous implant placement in either in the maxillary and mandibular region have been evaluated. Implant stability and increase in bone width achieved radiographically after ridge expansion is measured pre-operatively and post-operatively at 3 months follow up.

RESULTS:

The results obtained from our study indicate a significant increase in bone width in patients after ridge expansion of narrow alveolar ridges using expanders. The width gained was statistically significant. Implants were stable clinically and radiographically with 3 months follow up. All implants were surrounded by adequate amount of bone required for successful functional rehabilitation.

CONCLUSION:

This study concluded that predictable success can be achieved with simultaneous implant placement following ridge split technique. A significant bone width was achieved with good implant stability. Ridge split technique is an effective technique for horizontal expansion in atrophic alveolar ridge without the need for more complex treatment. It also decreases the rehabilitation time and improves bone support quality.

INTRODUCTION

Dental implants are the most recent and acceptable treatment procedure for rehabilitation of missing teeth. Dental implant is an artificial tooth root replacement and is used to support restoration that resembles a natural tooth or group of natural teeth.[1] In ancient days materials like carved bamboo pegs, copper pegs and seashells were used to replace the missing teeth. In 18th century researchers were began to experiment with alloys and gold.[2] In 1952, during a research the Swedish orthopaedic surgeon P.I**.** Brånemark observed that bone grow around titanium in rabbit, he decided to use this concept in rehabilitation of missing teeth and placed his first titanium dental implant in a human volunteer in 1965. In 1977 he coined the term osseointegration to explain the direct structural and functional connection between living bone and surface of a load carrying implant.[3]

Dental rehabilitation of partially or totally edentulous patients with implants has become common practice in recent decades, with predictable long-term results. Patients often desire a "fixed" denture rather than removable dentures, to feel normal and to overcome the psychological trauma they have been through. There are many benefits of fixed dental implant-supported prosthetics versus traditional crown and bridge or removable tooth-borne prosthetics.[4,5,6] Maintenance of residual bone, ease of oral hygiene, increased longevity, and non-involvement of adjacent teeth are a few advantages of using dental implants. However, unfavourable local conditions in the alveolar ridge may make rehabilitation with implants difficult or impossible because of insufficient bone, or unfavourable vertical, transverse, or sagittal inter-arch relation.[7,8] Following the extraction of teeth, the bony socket and adjacent soft tissue undergo a series of tissue repair processes. Histological evidence of active bone formation at the bottom of the socket and bone resorption at the edge of the socket are seen as early as two weeks after tooth extraction, and the socket is progressively filled with newly formed bone until about six months. Rapid bone remodelling subsides by this time but continuous bone resorption may persist at the external surface of the crestal area of the residual alveolar bone, resulting in considerable morphologic changes of the bone and overlying soft tissues over the years.[9] Gingiva overlying the ridge becomes rolled and soft tissue proliferates leaving hyper mobile ridge crest. The bone remodelling activity after tooth loss is localized primarily at the crestal area of the residual ridges, resulting not only in reduced height of the ridge but also in the creation of various three-dimensional shapes of the residual ridge. If the bone

resorption is greater at the crestal area than at the lingual or buccal areas, the residual ridges tend to be flat. In contrast, greater bone resorption at the lingual and buccal areas compared with resorption at the crestal area may result in the so-called ***knife-edge*** type of residual ridges.[9] Anatomic conditions of the jaws, systemic factors such as sex and age, hormonal balance, local inflammations and masticatory habits are supposed to act as co-factors in the development of atrophied ridges.[10] At present, patients are more inclined towards the dental treatments with better aesthetic results and less treatment time. The prosthetic treatments that have been used i.e. removable partial dentures, fixed partial dentures, or composite retained onlay partial dentures, in addition to the risk of complications, most of these treatments include the sacrifice of healthy tooth substance of the adjacent teeth.

Dental implants have overcome disadvantages of other procedures and emerged as an ideal replacement of missing teeth. Lack of sufficient bone to place an implant at the functionally and aesthetically most appropriate position is a common problem. This happens after the extraction of teeth if the patient has been missing teeth for a considerable period of time.[11] There is greater horizontal alveolar ridge reduction (29-63%) than vertical bone loss (11-22%) in first 6 months after extraction.[12] 50% of crestal width is lost in 1 year of post extraction. Placement of endosseous implants in atrophic ridges is often accompanied by various problems. Several methods have been described to augment the alveolar crest before or after implant placement to establish at least 1 mm bony wall around screw type implant.[13]

Various surgical widening techniques have been described, including lateral augmentation with or without guided bone regeneration (GBR), bone block grafting, onlay grafting procedure and alveolar distraction osteogenesis.[11] Although different techniques exist for reconstruction of atrophic ridge, there are chances of surgical risk, postoperative morbidity and multiple surgeries.

There are several techniques available to enhance bone volume for implant placement. These procedures include bone grafting, guided bone regeneration, and distraction osteogenesis.[10,13] Expansion of the existing residual ridge is another method to prepare the atrophic maxilla and mandible for implant insertion and augmentation. This approach has been referred to as ridge splitting, bone spreading, ridge expansion, or

the osteotome technique. The choice of treatment depends on numerous variables including clinician training and preference, anatomic region, degree of atrophy, arch relationships, prosthetic goals, aesthetic demands, economics, and healing time requirements.[9]

Expansion of the existing residual ridge is another method and is referred as ridge splitting, bone spreading, ridge expansion, split crest or the osteotome technique. Ridge splitting for root-form implant placement was developed in the 1970s by DR Hilt Tatum.[12] The ridge splitting technique is used to expand the edentulous ridge for implant placement or insertion of an interpositional bone graft.

Ridge split is also described for thin ridges before implant placement, ridge splitting involves the use of mallet which can induce greenstick fracture of the buccal cortical bone. In the ridge splitting procedure, discomfort to patients is often substantial because of maleting and there is a risk of buccolingual bone fracture when excessive force is applied.[14]

Bone expansion in narrow alveolar ridges can be achieved by bone expansion screws, which widens the space between the two cortical bones. Bone expansion was first introduced by summer in 19948. It is a single step technique in which creation of implant site begins using smallest cylindroconical expansion screws, it is followed by successively increasing diameter from expansion screw to the next by this technique the desired bone expansion is achieved till the desired dimension of the implant to be placed.[15]

Ridge splitting repositions the cortical plates around the implants following which bone regenerates within the space between the expanded cortical plates.[16] Thus, the advantages of ridge splitting over other techniques are reduced treatment time, lesser overall cost, no need of barrier membranes or bone graft material and no morbidity related to second donor site.[9]

The purpose of the present study is to evaluate the efficacy of Ridge Split technique in horizontally deficient ridges for implant placement.

AIMS
&
OBJECTIVES

Aim

The aim of this study is to access the efficacy of the ridge split technique in horizontal alveolar ridge augmentation for implant placement.

Objectives

The objectives of this study are-

- To evaluate width of the alveolar ridge gained with ridge split
- To evaluate the primary and secondary implant stability.
- To evaluate the total crestal bone loss.
- To evaluate any complication related to ridge split technique the procedure.

REVIEW OF LITERATURE

Tomaso Vercellotti (2000) concluded that modulated-frequency piezoelectric energy scalpels, permits the expansion of the ridge and the placement of implants in single-stage surgery. The technique involves the separation of the buccal and palatal cortical plates and immediate positioning of the implant between the 2 cortical walls.[17]

Gary W. Coatoam and Angelo Mariotti (2003) conducted a segmental ridge-split procedure (SRSP) representing another method for the augmentation of edentulous ridges. SRSP may be used prior to or at the time of implant placement. The procedure facilitates the placement of implants into areas that otherwise would not be suitable for implants. The use of heme-reconstituted DFDBA in our technique is a distinguishing difference between our procedure and earlier procedures reported by Simion et al. and Scipioni et al. Because bone grafting in the SRSP all takes place within a surgically created bony crypt, the potential for bone reconstruction is significant. In creating this crypt, it is important to encapsulate the bone graft material within bone plates and overlying periosteum.[18]

Mohit Kheur (2004) concluded that the staged ridge split approach is a safe and predictable approach as compared to single-stage ridge split, especially when combined with the use of piezo surgery. This technique is not technique sensitive and presents minimal risk of damage to adjacent hard and soft tissues. This technique can be successfully used for augmentation of compromised mandibular alveolar ridges.[19]

Misch C. M. (2004) concluded that Ridge splitting techniques are useful for managing the narrow edentulous ridge for implant placement or interpositional bone grafting. Although this surgical approach may be used in both jaws, it is better suited for the maxilla. In addition, ridge splitting is limited to treating ridge width deficiency. The cortical plates of the residual ridge must be carefully split while maintaining periosteal attachment. A significant advantage of this technique is that it allows simultaneous implant placement. Proper patient evaluation and case selection is essential to achieving a successful surgical and prosthetic outcome. Clinical experience has shown that the ridge splitting technique can be a useful method for managing the narrow residual ridge. Careful preparation of the bone and maintenance of an attached periosteum are critical to the formation of new bone around the interproximal surfaces of the implants. Wound healing in these cases is similar to the fracture repair of bone.

The gap fills with a blood clot that organizes and is replaced with woven bone. This immature osseous tissue develops into load-bearing lamellar bone at the implant interface.[20]

Basa S, Varol A, Turker A (2004) concluded that the split-crest bone expansion technique may be indicated for sharp mandibular and maxillary ridges in patients whose bone quantity is inadequate for primary stabilization. Slight separation of a maxillary ridge crest is performed as a hinge-like separation of the buccal cortex. It is difficult to achieve the same hinge-like separation in the posterior mandible because of the compact outer cortex and external oblique line. The posterior mandible is the most difficult region for reconstruction and early implant placement in cases of severe alveolar resorption in the maxillomandibular complex. Onlay grafting with biodegradable membranes and autografts is the most frequently used technique; however, this technique involves a long ossification period, and the tendency of the graft material to resorb can easily decrease bone quality and quantity.[21]

Arun Garg et al (2009) concluded that the concept of the ridge-splitting procedure was developed. The technique offers an appropriately sized space for implant insertion while maintaining natural vascularity on all four surfaces of the implant site. For stability, the ridge must be split enough for the implant to enter the basal bone. The technique offers an appropriate space for implant insertion while maintaining natural vascularity on all four surfaces of the implant site. For stability, the ridge must be split enough for the implant to enter the basal bone; however, over-manipulation with a hammer and chisel can damage adjacent teeth and risks damaging the floor of the maxillary sinus. The new technique offers a unique and delicate way to penetrate basal bone with a minimum of physical force applied to the implant site. Not only does this decrease the possibility of adverse events, it actually enhances patient intra- and perioperative comfort. It is also possible that local soft-tissue healing time may be decreased due to the gentler technique.[22]

Dan J. Holtzclaw et al (2010) demonstrates that the ARS procedure can achieve substantial gains in horizontal ridge width of the edentulous posterior mandible without associated morbidity. This retrospective observational report demonstrates that the piezoelectric hinge–assisted ridge split procedure can achieve substantial

gains in horizontal ridge width of the edentulous posterior mandible without associated morbidity. Further prospective and larger observational studies are warranted to see if this is true over a larger patient population and to compare this technique to other more traditionally used approaches.[23]

R. Gonza´lez-Garcı´, F. Monje, C. Moreno (2010) concluded that this technique provides an acceptable inter-cortical gap, decreases the risk of necrosis of the outer cortex, and firm-wall box for the placement of particulate bone grafting, by means of the split-crest technique predictable results in terms of bone regeneration of the osteotomy lines and implant overall survival were obtained.[24]

Sohn D, Lee H, Heo J, Moon J, Romanos I (2010) discussed that the lateral ridge expansion technique is useful for managing the narrow edentulous ridge for implant placement. Careful expansion of the buccal plate is essential when the lateral expansion technique is used because abnormal bone healing can result from undue trauma to the plate. The lateral ridge expansion technique with simultaneous immediate implant placement is usually performed because it shortens the total treatment time. However, in the mandible, the risk of malfracture of the osteomized segment is great because the mandibular bone has less flexibility and a thicker cortical plate. Ridge expansion with simultaneous implant placement has resulted in several complications such as a lack of initial stability for the implants, fracture of the buccal segmented bone, and compromised implant placement in the buccolingual and apico-coronal direction. The lateral ridge expansion technique is very effective for horizontal augmentations in severely atrophic posterior mandibular ridges. In the mandibular ridge, which has low bone quality and a thin cortex, immediate lateral ridge expansion can be a useful procedure. Delayed lateral ridge expansion can be used more safely and predictably in patients with high bone quality and a thick cortex and narrower ridge in the mandible to avoid complete fracture of the buccal segments.[25]

Sakamoto Y. et al (2011) concluded that daily practice of dental implants, it becomes an inevitable challenge to place the implants in the severe cases such as the narrow or shallow alveolar ridge. It has been known that the sprit crest technique and the socket lift procedure played an important role in those difficult cases. The purpose of this

paper is to make clear the clinical notes and the efficacy of split crest and socket lift procedure for the difficult cases of implant placement such as a thin alveolar ridge. The most important point is thought to be the appropriate choice of clinical cases in terms of both cosmetic and functional viewpoints, and one of the significant clinical findings for split crest cases is that the height of the alveolar ridges should be sufficient, even though those widths are narrow.[26]

Len T et al (2013) concluded the study on predictability of an RSP in cases of narrow alveolar ridges that can be widened in preparation for an implant placement. The staged approach to implant reconstruction by ridge splitting tends to have a higher implant success rate and better buccal cortical bone preservation. Initial clinical evaluation supplemented by radiographic images helps in most cases to distinguish two-dimensional (2D) versus 3D alveolar bone deficiency. Although minimal bone loss and patient's lack of desire to go through grafting surgical procedure(s) can be circumvented with restorative means, extensive bone atrophy usually requires surgical correction for a proper implant placement. Alveolar bone should be initially assessed clinically (visually) for a rough width and height analysis and interarch-occlusal relationships. In some cases, although 7–8 mm of bone width is present, it could be lingually (palatally) positioned and therefore might require an additional buccal bone grafting for a proper restoratively driven implant insertion.[27]

I.Milinkovic, L. Cordaro (2013) concluded that the use of the ridge expansion/splitting technique in the augmentation of horizontally deficient ridges (mean ridge width 3.37 mm). With this technique, a linear bone gain of 2.95 mm can be observed. In summary, 943 implants were placed in 307 patients, with a simultaneous approach. Only in one study42 were both simultaneous and delayed (staged) approaches performed. The bone augmentation procedure used for the correction of the horizontally insufficient ridge was a sagittal osteotomy with a ridge expansion technique. The purpose of the a forementioned procedure is to widen the narrow crest, in order to place standard-diameter dental implants that also maintain the osteotomized segment. In four studies, additional grafting material was used to fill in the remaining space.[28]

Khairner M S, Khairner D, Bakshi K (2014) concluded that the final aesthetic outcome with pre-operative and post-operative smile after 1 year shows aesthetically satisfactory result with ridge split technique. The post-operative X-ray after one year shows very minimal bone loss at crest.[29]

Ioannis P. et al (2014) concluded that the advantage of the ARST is that implants can be inserted at the same time as the bone is widened, which reduces morbidity as well as treatment costs and time. conducted a study on insufficient width of the alveolar ridge which often prevents ideal implant placement. Ridge split technique is used for the augmentation of alveolar ridge. It was found that ridge split technique is minimally invasive technique indicated for alveolar ridges with adequate height which enables immediate implant placement and eliminates morbidity and overall treatment plan. Horizontal atrophy of the alveolar ridge usually complicates adequate implant placement. GBR, bone grafting, alveolar ridge splitting and combinations of these techniques have been suggested as treatment modalities to increase bucco-lingual dimension of the residual ridge. The ridge splitting technique is used for the horizontal augmentation of narrow alveolar ridges and allows simultaneous implant placement.[30]

Ella et al (2014) concluded that horizontal expansion of the ridge is easily reproducible, in very narrow ridges a lack of bone substitute resulted in significant resorption of 3-5 mm of wide crests 5% and even after expansion, a bone substitute should be placed after bone expansion. Horizontal expansion using the crest control device is certainly reproducible and can be good alternative to bone block grafting in narrow ridge. The ridge bone must have minimum width and there must be a minimum amount of cancellous bone between the cortical plates to prevent fracture during surgery and the very probable risk of post operative resorption in short or medium term. This technique prevents the need for donor site bone and must be compared with osteo-periosteal flap.[31]

Arora V, Kumar D (2014) Ridge splitting techniques provide the advantage of ridge expansion and simultaneous implant placement in management of narrower ridges. Although, this surgical approach may be used in both jaws, it is better suited for the maxilla. Proper patient evaluation and case selection is essential to achieve a successful surgical and prosthetic outcome. Ridge splitting for root-form implant

placement was advocated by DR Hilt Tatum in 1970. Tatum developed specific instruments including tapered channel formers and D-shaped osteotomes to expand the resorbed residual ridge. Clinical experience has shown that the ridge splitting technique can be a useful method for managing the narrow residual ridge. Careful preparation of the bone and maintenance of an attached periosteum are critical to the formation of new bone around the dental implants. The process of formation of new bone in these cases is similar to the fracture repair of bone.[32]

Craig M. Misch (2014) concluded that the ridge splitting technique is used to expand the edentulous ridge for implant placement or insertion of an interpositional bone graft. This technique is only suitable for enhancing ridge width. There must be adequate available bone height for implant placement, and no vertical bone defect should be present.[33]

Len Tolstunov (2014) conducted split-ridge procedure which included the lack of a donor site and that the buccal flap is not compromised but left attached. A postoperative injury while chewing is less likely with the ridge-split method because the graft is positioned more internally, protecting the area and ridge-split treatment has many advantages and produces a stable graft over time.[34]

Basel E et al (2015) conducted a study on Unavoidable bone resorption occurs after tooth extraction for which bone augmentation approaches must be used when opting for oral rehabilitation with dental implants. Indeed, a wide variety of studies have described successful outcomes with numerous techniques/approaches.[35]

Reenesh Mechery, N. Thiruvalluvar, A. K. Sreehari (2015) concluded that ridge split or spreading are advocated in cases where ridge width is >3.5 mm. The most important factor for successful ridge split cases is careful patient selection and bone evaluation. Generally, the site heals similar to fracture repair of bone wherein, the gap is filled by clot that organizes over a period and is replaced with woven bone and later by load bearing lamellar bone at the interphase. Although, this surgical approach may be used in both jaws, it is better suited for the maxilla. Thus, to satisfy the ideal goals of implant dentistry augmentation of deficient alveolar ridges is an important aspect

of dental implant therapy with the end goal to provide functional restoration that is in harmony with the adjacent natural dentition.[36]

Kher U (2015) successful ridge split procedure is achieving primary stability for the implants, intactness of the buccal bone fragment, good soft tissue coverage and an undisturbed healing period. The commonest complications associated with the surgery are wound dehiscence, inadvertent fracture of the labial plate during manipulation and extensive resorption of the labial bone during the healing phase. However, when performed in the correct clinical situation, it is an effective way of placing implants in a good restoratively driven position.[37]

J. Waechter et al (2016) concluded that implant installation during the RST, this one-stage surgery is almost always possible. Additional advantages of simultaneous implant placement include a shortened time between the first surgery and prosthetic treatment. Furthermore, immediate implant installation requires lower amounts of biomaterials, reduces costs, and also prevents the collapse of the expanded cortical walls. Finally, it also results in less discomfort for the patient, who will undergo only one surgical procedure. And demonstrating that this technique is effective at increasing bone thickness in the buccal-palatal and buccal-lingual cross-sections when performed on ridges without sufficient bone thickness. An average bone gain of 3.8 mm is expected independent of the surgical instruments used to cut bone, i.e., piezoelectric instruments (US) have no advantages with respect to conventional instruments for bone gain. These results are comparable to those achieved in favorable conditions with a bone bed of sufficient thickness and hence SCT effectively increases the volume of the atrophic ridge, allowing successful im-plant installation. [38]

Shakir Q J, Pailwan N D, Patil D U (2016) concluded that there are many methods for augmentation for implant placement in deficient alveolar ridges of which ridge split or spreading are advocated in cases where present ridge width is minimum of 2.5 mm, The most important factor for successful ridge split cases is careful patient selection and bone evaluation.[39]

Zahran A et al (2016) concluded that the modified approach to split -crest technique as presented, is a successful technique for augmenting narrow maxillary ridges and

implant placement. Ridge split-crest bone manipulation technique is one form of augmentation procedures for narrow ridges. This procedure can be used for ridge expansion with immediate implant placement, providing an overall reduction in the time required for implant therapy. Since the introduction of this technique various studies have reported the use of osteotomes and ridge expanders to increase ridge width for the placement of implants with successful outcomes. In the current study, tapered implants were used to expand the bone instead of using ridge expanders or osteotomes and this was considered as a valuable modification to the split crest technique. Tapered implants provide more control over the expansion procedure by easing the bone plates apart in a gradual manner which minimizes the risk of fracturing the buccal plate. The expansion of the ridge and placement of the implants are combined into a single procedure. Few instruments were employed: the piezoelectric cutting tip, the tapered drill and the tapered, self-tapping, self-drilling implants which are placed into predetermined osteotomies within the split channel. No bone grafts or barriers were used to augment the osteotomy site. The self-space-making nature of the split channel allowed for natural bone regeneration by the osteogenic cells.[40]

Juan Reyes Doimi, Guillermo Mauricio Aguirre Balseca, Andreé Cáceres La Torre (2017) concluded that Split-crest technique allows primary stabilization of tooth implants in atrophied bone ridges by means of bone expansion. This technique can be indicated as an alternative to regenerative procedures avoiding morbidity of donor sites, decreasing the number of surgical procedures and treatment time. Nevertheless, bone defect morphology is an important consideration for the techniques' suitability. Requirements are: an alveolar ridge mostly composed of medullar bone, with a wide base and crest in the shape of a knife blade, with sufficient bone height (10 mm at least) and width of 3 to 5 mm. Thus, the technique purports the objective of creating a space through the division of the bone crest into two sections, with greenstick longitudinal fracture, allowing immediate insertion and stabilization of implants in the most apical, non- fractured portion of the bone ridge. The Split Crest technique provided horizontal ridge increase of about 1-4 mm; the upper jaw exhibited the greatest increase (4-3 mm) when compared to the lower jaw (1-1.5 mm). Likewise, greater numbers of complications have been reported when this technique has been used in the lower jaw. Therefore, indications for this procedure are more frequent and bear better prognosis when used in the upper jaw.[41]

Moro A. et al (2017) concluded that the alveolar ridge split technique with simultaneous implant placement is usually performed to shorten the total treatment time and to eliminate second surgical procedure morbidity.[42]

Parthiban P. S et al (2017) concluded that traditional ridge augmentation techniques, ridge split technique allows for immediate implant placement following surgery and eradicates the possible morbidity from a second surgical site.[43]

Delai V et al (2017) The present case demonstrates that the split crest technique associated with the immediate installation of implants is effective and safe when correctly indicated and allows the reduction of the surgical steps, decreasing morbidity when compared to alternatives bone graft techniques. The installation of the implants immediately after the split crest technique, biologically behaves in the same way of an implant located in a fresh tooth socket. In this surgical procedure, only the apical portion of the implant was located in the alveolar bone, with insertion torque only in contact with the labial and lingual walls. Thus, it was expected that, similar to immediate implant installation after tooth extraction, bone remodeling during healing occurs and the bone tends to displace apically. A study proves the effectiveness of the split crest technique, with a success rate of 95%. The method of expansion with osteotomes is used frequently and of great utility in certain patients with maxillary bone atrophy. The use of rotatory conical osteotomes also has demonstrated satisfactory result. Other less sophisticated techniques using of Beavers blades no.64, chisels and osteotomes for recovery of the bone volume also have been effective. [44]

Ramal A, Masri M E, Shokry M, Attia N (2018) evaluated the outcome of modified ridge split technique in posterior mandible in comparison to conventional technique and concluded that the modified approach for mandibular ridge split as presented, is a successful technique for augmenting narrow mandibular ridges. Rehabilitation of long standing edentulism in posterior mandible with horizontal bone loss can be performed with relative ease by modified ridge split technique. It omits the need of second surgical site or any foreign materials. Modified ridge split technique is simple and predictable with satisfactory results, minimal morbidity and low cost. It can be concluded that modified ridge split technique in posterior mandible is a simple and

predictable procedure with satisfactory results. Moreover, this approach is devoid of foreign materials usage and has a low rate cost, therefore, could be employed more often.[45]

Nazife Begu¨m Karan, Hu¨seyin Ozan Akinci et al, (2019) concluded that presented study showed the benefits of a promising treatment option for horizontal ridge augmentation of the posterior maxilla prior to implant placement. This novel technique provides a high-degree primary graft stability without the use of any fixation appliances. concluded the study on technique for the horizontal augmentation of the atrophic alveolar bone, prior to the implant placement. The application of the proposed technique showed that the quality of the bone area around the implants can be enhanced by transferring a bone block into the planned surgical area, and the desired level of stability for the implants can easily be achieved. The authors believe that this technique can be used as an alternative treatment option for the horizontal discrepancies, accompanying insufficient bone density.[46]

Housam A et al (2019) concluded the study on the effectiveness and predictability of split ridge to increase the width of deficient ridge. In contrast to traditional techniques, it allows immediate implant placement following surgery and eradicates the possible morbidity from a second surgical site.[47]

Romesh Soni (2019) concluded that concludes that a patient with horizontal bone defect can be successfully rehabilitated by implant retained prosthesis when sufficient bone volume is achieved by involving ridge split technique along with bone grafting further supported by guided bone regeneration with collagen membrane as barrier membrane.[48]

Thomas Starch-Jensen1, Jonas Peter Becktor (2019) concluded that the split-crest technique seems to be useful for horizontal augmentation of maxillary alveolar deficiencies with high survival rate of prosthesis and implants and indicated that maxillary alveolar ridge expansion with split-crest technique and immediate implant placement is associated with obvious advantages for the patient including reduced morbidity, less invasive and reduced length of the operation time and hospitalization. However, lack of comparative long-term randomized trials assessing the two

treatment modalities has made it difficult to choose the most reliable and predictable augmentation technique.[49]

I. Kumar, H. Singh, S.S. Arora, A. Singh & N. Kumar (2019) concluded that the objective of ridge augmentation is to increase the height and width of the ridge so as to rehabilitate edentulism with fixed implant supported prosthesis. Plethora of clinical approaches has been developed to increase the width/height of the alveolar ridges to fulfil the requirement of implant placement in atrophic ridges. The RST procedure in combination with immediate implant placement has been described more than 20 years ago. The main goal that has been achieved with ridge splitting was the gain of bone width with simultaneous implant insertion and integration.[50]

Singla Y, Sharma R (2020) concluded that the technique of ridge split or ridge expansion used for horizontal ridge augmentation while maintaining the periosteal attachment by carefully expanding the cortical plates. This technique had an added advantage of augmentation and implant placement in a single sitting. Ridge splitting techniques are useful for managing narrow edentulous ridge (>3.5 mm) for implant placement with predictable outcome in maxilla than in mandible.[51]

Khalid Al Hamdan, Razan Alaqeely, Abeer Ahmed Gamal (2021) concluded that the fast and non-invasive nature of ridge splitting, and the superior bone healing observed after the application of this technique entails that careful planning and utilization of instruments when splitting and expanding the ridge can provide a high standard treatment for function and esthetics with low morbidity and a short treatment time. Splitting and expanding the edentulous ridge for bone augmentation and implant placement is considered to represent an innovative technique because it avoids the need for a second surgical site, which further reduces the ailment of the patient. The split ridge technique (SRT) is recommended when the ridge width is insufficient, but the alveolar height is acceptable. However, in ridges with low elasticity, trabecular bone volume is compromised, and bone expansion will be less predictable. This can undermine the success of the technique.[52]

Goyal M et al (2021) concluded that fast and non-invasive nature of ridge splitting, when opting for rehabilitation. In mandibular ridge with dense cortical plates, ridge-splitting can be performed using either two-stage or one-stage approach. The choice between the two depends on the availability of armamentarium and surgeons' skill. The one-stage conventional approach is preferred only when the surgeon has adequate experience supported with suitable armamentarium, e.g., piezo surgery. Only modification here in one stage ridge-splitting for mandibular ridge compared to conventional ridge split is raising flap from either buccal or facial side compared to both sides in conventional technique. Thus, ridge splitting and implant placement at re-entry after 3-4 weeks becomes easier. Due care is taken to raise the flaps only minimally. The peri implant spaces are filled with particulate graft and the lingual flap is coronally advanced and sutured back. Uncovering of implants and functional loading is done after 4-6 months.[53]

MATERIALS & METHOD

Study Design:

- A total of 10 Patients reporting to the Out Patient Department of Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow undergoing surgery under local anesthesia were included in this study.

Method of collection of data:

- The patients under study were ASA Class I and relatively healthy ASA Class II patients. Blood investigation, CBCT and OPG was taken preoperatively and OPG, CBCT immediate post-operatively for all patients.

Selection criteria:

Ethical clearance was obtained by the ethical committee before the Commencement of the study. The patients were selected on the basis of certain present inclusion and exclusion criteria.

Inclusion criteria: -

- ASA Class 1
- Patient with resorbed alveolar ridge in horizontal dimensions.
- Patients willing to participate in the study.

Exclusion criteria: -

- Smokers, deleterious habits.
- History of radiation therapy to the head and neck region.
- Patients having psychological diseases, e.g., schizophrenia.
- Specially abled patient.
- Patients unwilling to participate in the study.

For clinical evaluation following criteria were considered-

- width of the alveolar ridge gained with ridge split
- primary and secondary implant stability.
- total crestal bone loss.
- complication related to ridge split technique the procedure.

Materials and Armamentarium:

The following standardized materials and equipment/armamentarium were used for the study.

A. Implant: selective integrated surface (sand-blasted & acid etched surfaced) were used. These are two piece implants made of commercially available titanium alloy. The length of implant ranged from 10mm to 11.5mm with a diameter 3.3 and 5 mm.

B. Surgical Armamentarium:

1. Contra angle Hand piece and Micro saw (7mm,10mm) : used to perform initial osteotomy on mid crestal bone.

2. Surgical Guide Drill: Conventional (No.4 or No.5) round bur was used to initiate the bone drilling.

3. Bone Expansion Kit: Cylindroconical screws with increase in diameter.

4. Surgical Implant Kit With Surgical Twisted Drills: Surgical twist drills of various diameters ranging from 2.0mm to 5 mm were used in sequence to prepare the site.

5. Depth Gauge/Paralleling Pins: These gauges were used to obtain parallel preparation and to guide the direction of drilling preparation. They were also used to measure the depth of the surgical preparation for implant placement.

6. ATR (Advanced Technology Research) Advanced Physio-dispenser
Hand piece with internal irrigation: used for bone drilling.

8. Torque Ratchet: Hex ratchet was used to engage the fixture insertion tools to screw the implant in its proper position.

9. Standard Diagnostic Tools: Bowls, Tongue depressors, Cheek retractor, Minnesota Retractor, Mouth mirror, Probe, Tweezers, periosteal elevators, BP blade (No.15) and handle, Curettes, tissue holding forceps, Needle holder, Scissor and Silk suture material were used.

Surgical Procedure for Implant Placement-

• Lignocaine HCL + 2% Adrenaline 1:80000 was injected in the area of surgery as local anaesthesia.

• After administration of local anaesthesia, incision was made along the ridge crest and extended at least one tooth adjacent on both sides of the edentulous region.

• A full thickness mucoperiosteal flap was raised on the buccal and lingual aspects but minimal tissue reflection was done in order to preserve the periosteum attachment surrounding the buccal and lingual bone.

• The knife edge ridge was reduced horizontally with the help of rotary cutting instrument to achieve horizontal platform approximately 3mm. The horizontal osteotomy cut was made using thin micro saw, 1 to 2 mm away from the adjacent tooth from distal to mesial direction under saline irrigation at the speed of 1200 to 1500 rpm. The osteotomy line was deepened further with wider disk.

• A twist drill 1.8mm was used to reach the desired depth of osteotomy according to the length of the implant to be placed. The ridge expansion began using smallest cylindroconical expansion screw, followed by successively increasing diameter from

one expansion screw to next screw at the implant site, till the sufficient amount of uniform bone expansion was achieved.

• After sufficient expansion of the ridge was achieved, final bone drilling was performed at the revolutionary rates of 800 rpm under copious saline irrigation.

• A self-tapping implant was inserted in the prepared site. A titanium cover screw supplied with the implant was inserted on the implant with the use of implant screw driver.

• The reflected mucoperiosteal flaps were sutured using black braided silk suture material.

• Patient was advised Chlorhexidine (0.12%) mouth rinse twice daily for further two weeks. Suture removal was done 7 days postoperatively.

Parameter assessment:

Patients for surgery were selected irrespective of gender, religion or socio-economic status. The parameters assessed included-

Pre - operative-

1. Blood investigation
2. CBCT

Intra-operative-

1.IOPAR

Post – operative –

1.CBCT

Type of study

All the variables were analysed using Prospective cross-sectional study. Statistical significance was defined as $P<0.05$.

PHOTOGRAPHS

Armamentarium

Fig 1: Physio dispenser

Fig 2: Bone Expansion Kit and Implant Kit

CASE 1

Pre OP Pictures

Fig 3: Frontal View

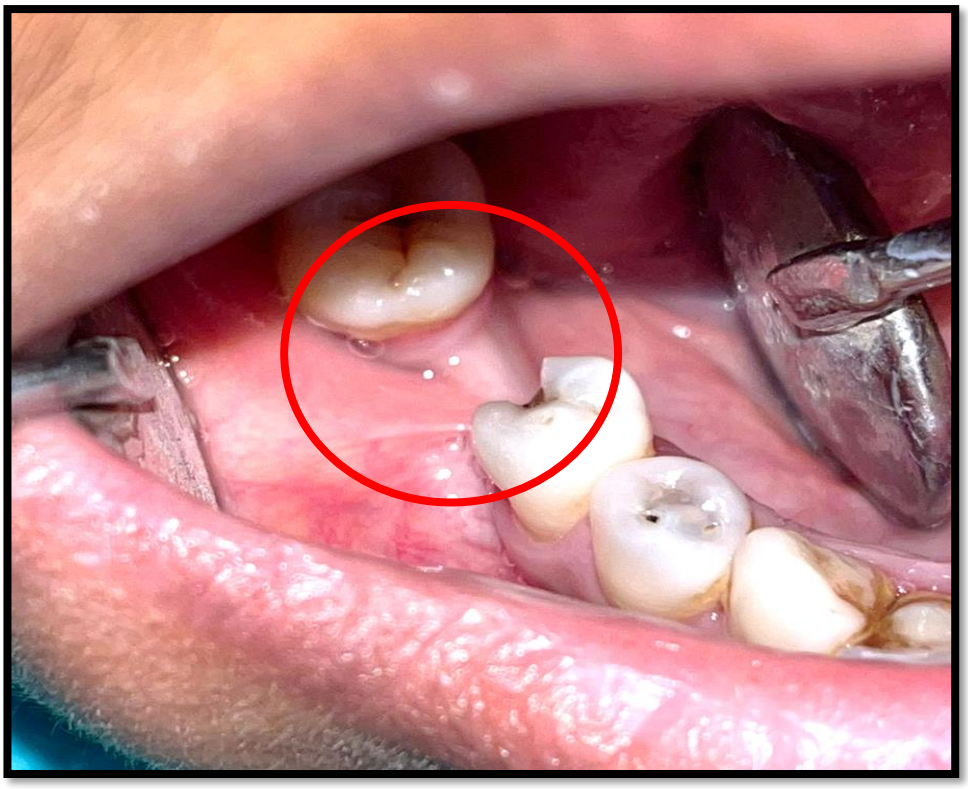


Fig 4: Pre-OP Picture of region 46 with knife edge ridge

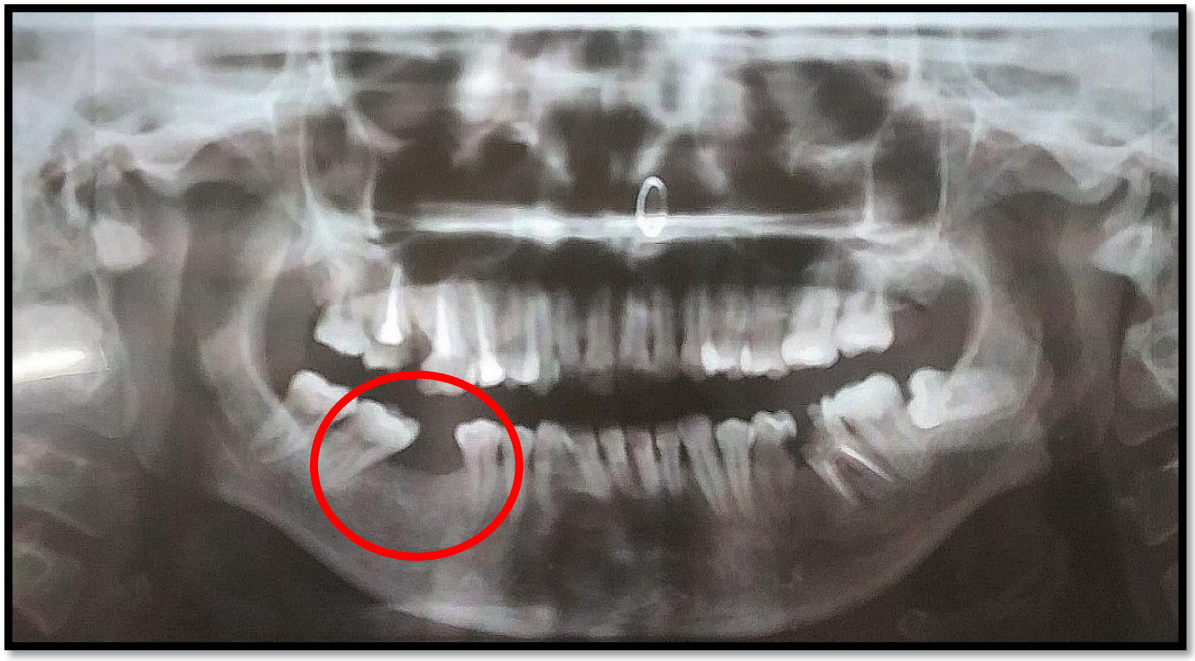


Fig 5: Pre op OPG showing edentulous 46 region

Pre OP CBCT

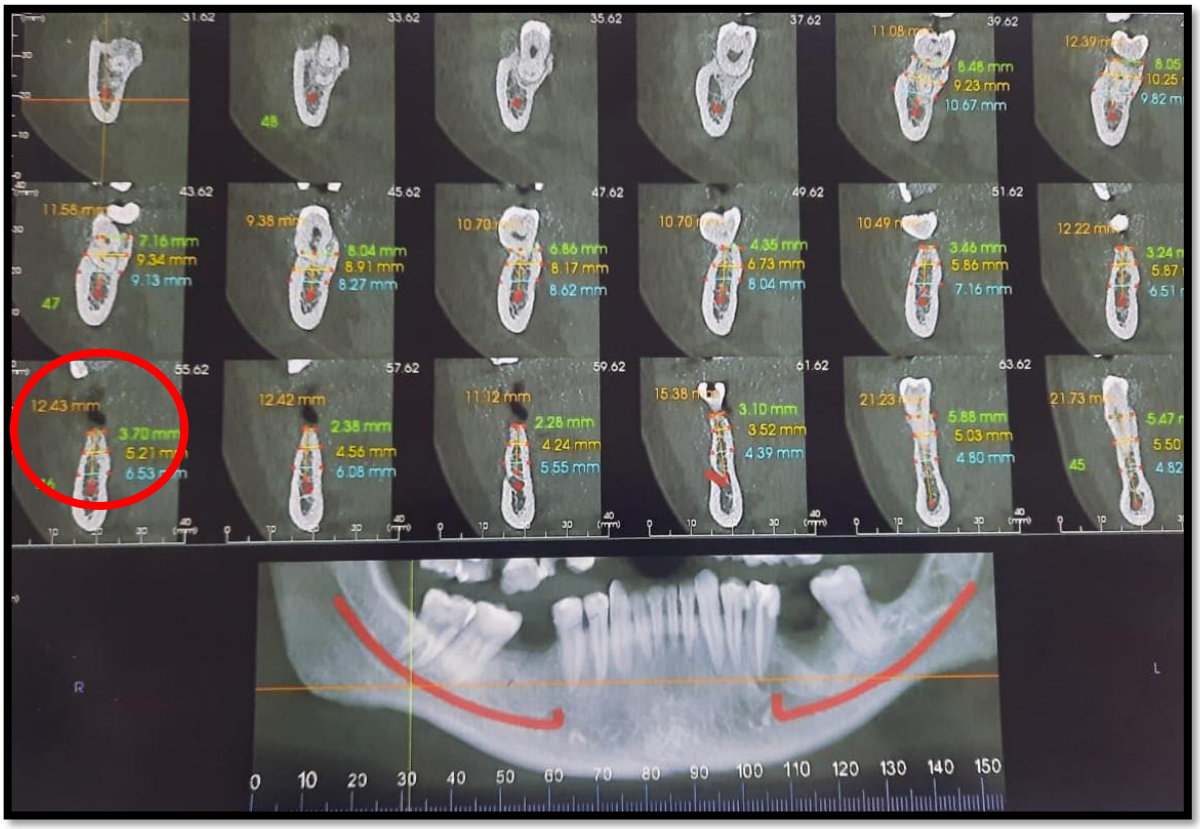


Fig 6: CBCT - coronal section

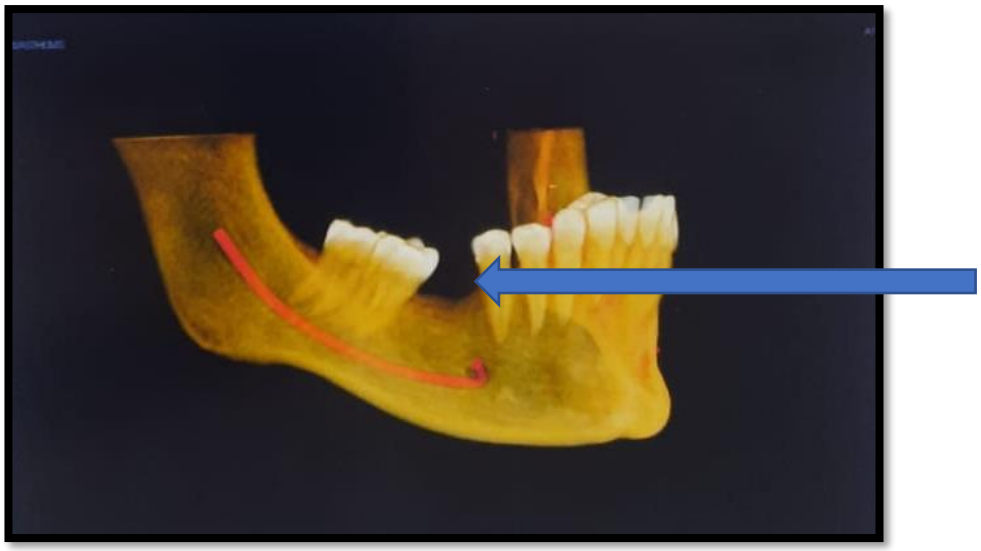


Fig 7: 3D Reconstruction (arrow showing knife edge ridge)

Intra OP Pictures

Fig 8: Crestal incision with 15 no BP blade

Fig 9: Ridge Splitting by Microsaw

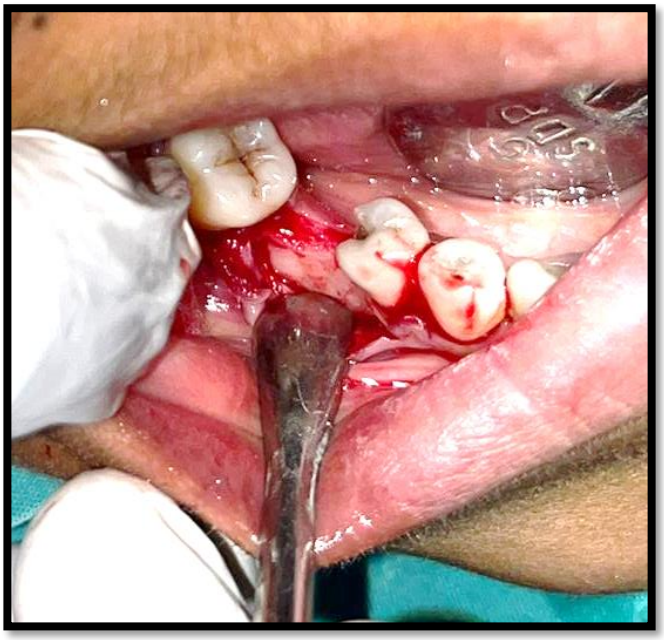


Fig 10: Ridge splitting done

Fig 11: After separating buccal and lingual cortical plates

Fig 12: Osteotomy done (size 4.2/10)

Fig 13: After completion of osteotomy

Fig 14: Implant placement by hand rachet

Fig 15: ISQ value recording by RFA device

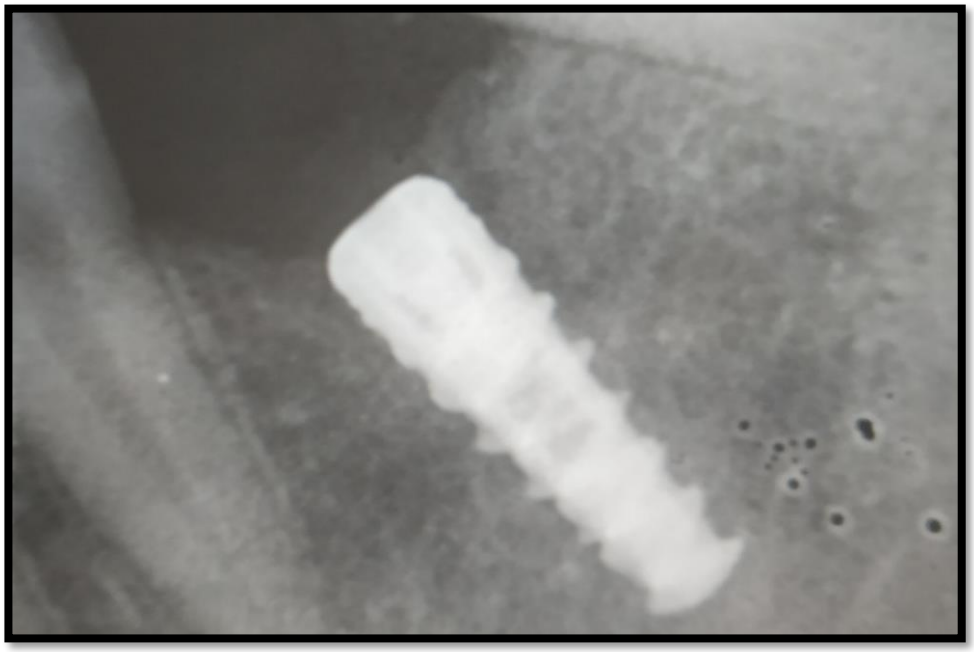


Fig 16: Immediate RVG wrt 46 region after implant placement

Post OP CBCT after 3 Months

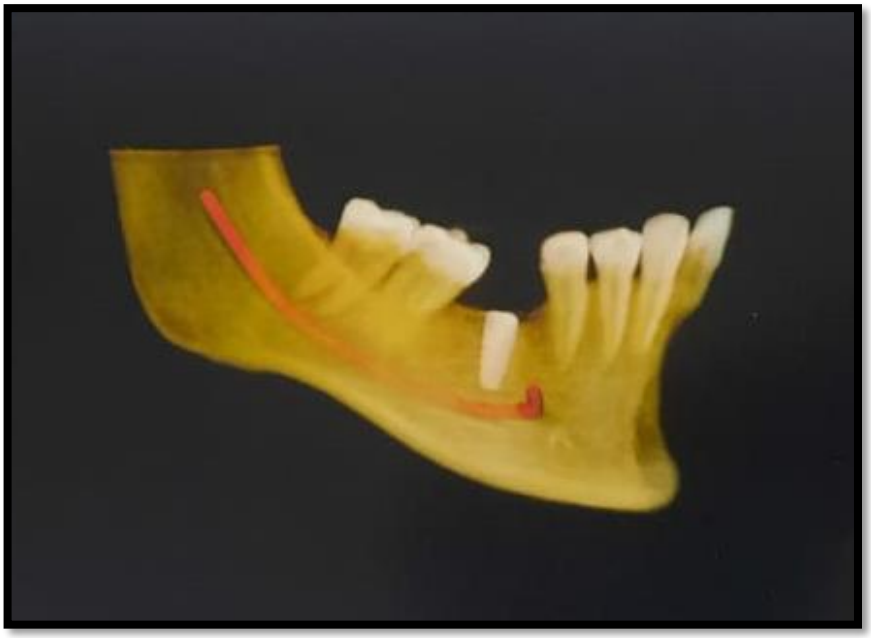


Fig 17: 3d Reconstruction

Fig 18: Axial View of CBCT

Fig 19: Post Op CBCT in coronal view

Case 2

Pre OP Pictures

Fig 20: Frontal View

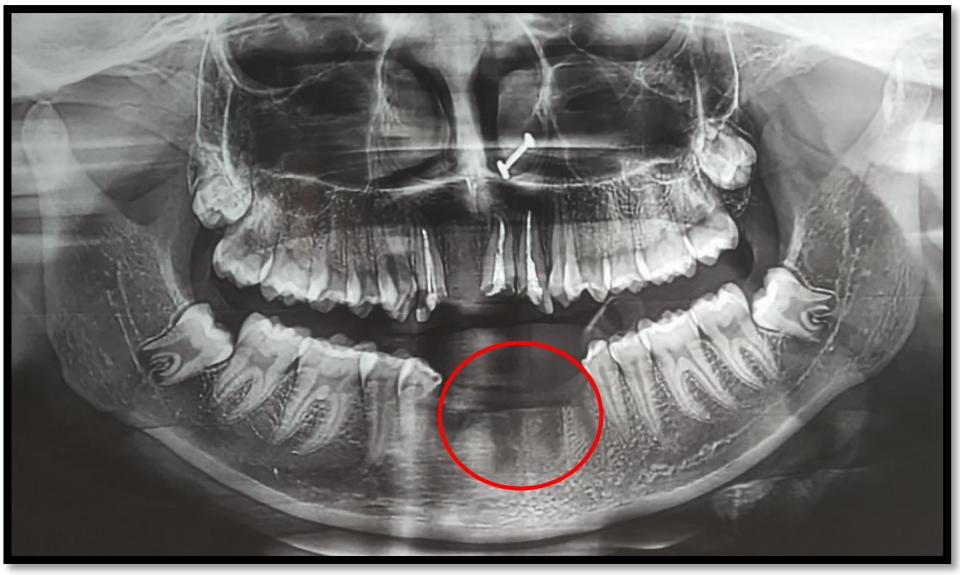


Fig 21: Pre op OPG of case 2 showing edentulous mandibular front region

Fig 22: Clinical picture showing resorbed ridge wrt 31,32,33, 41,42,43

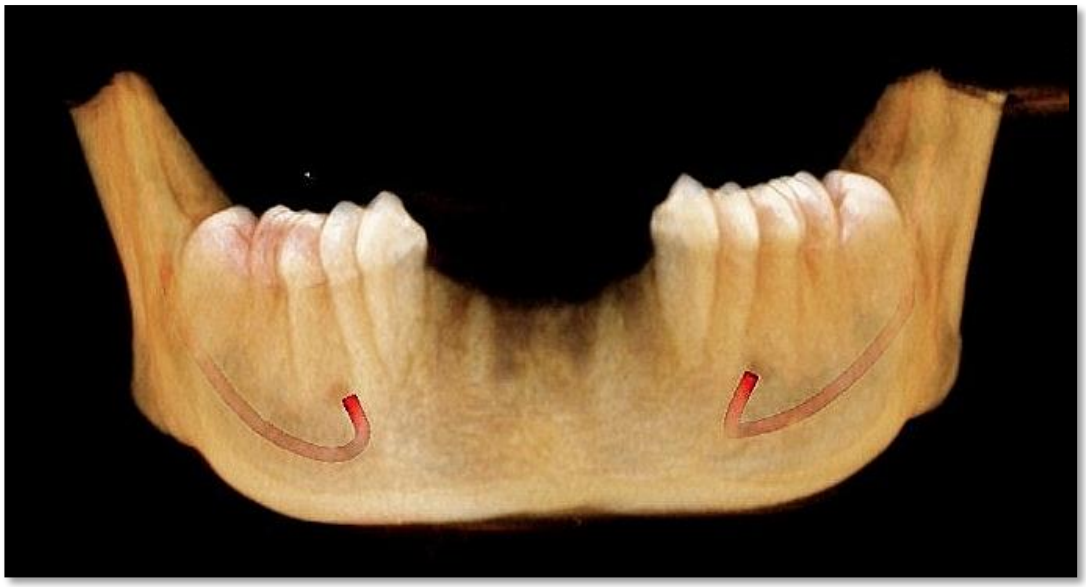


Fig 23: 3D reconstruction of the mandible

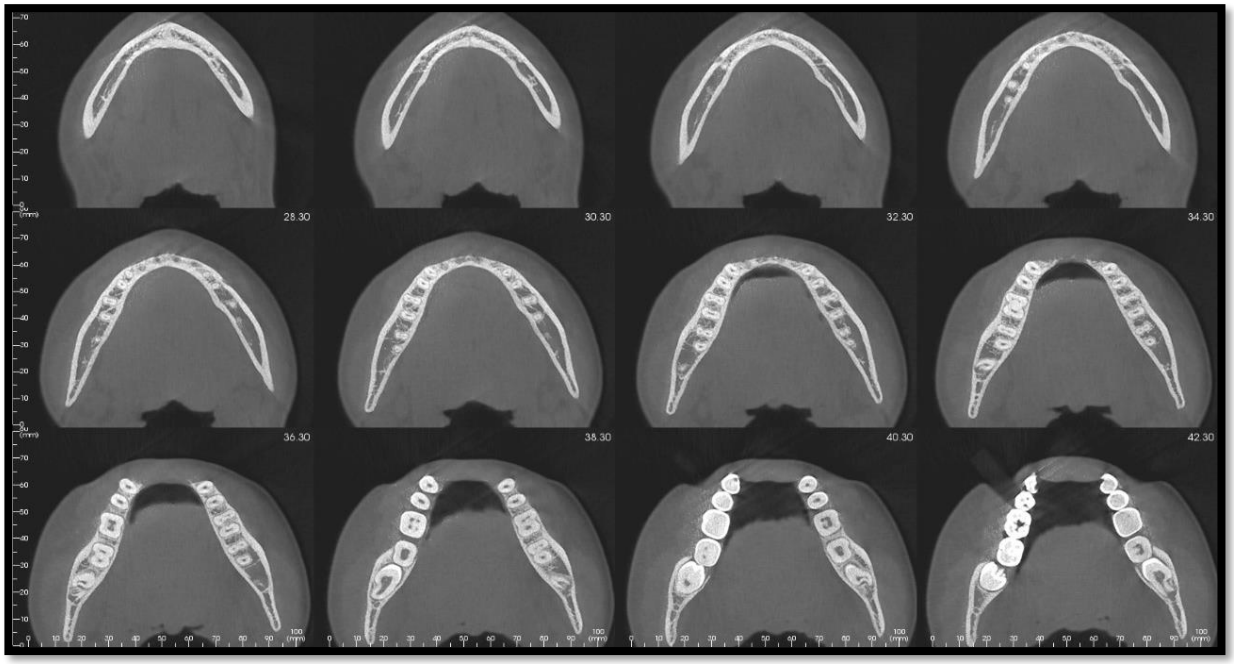


Fig 24: CBCT - axial view

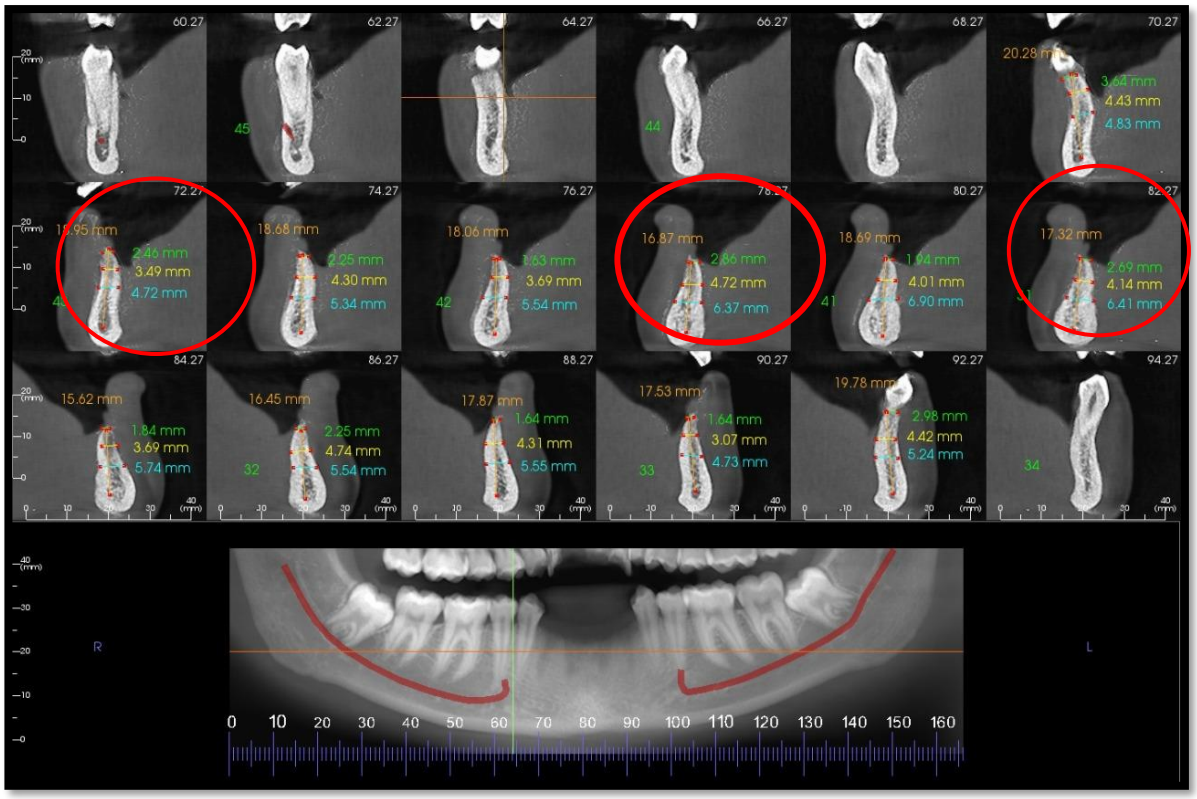


Fig 25: CBCT - coronal view

Intra Op Pictures of Case 2

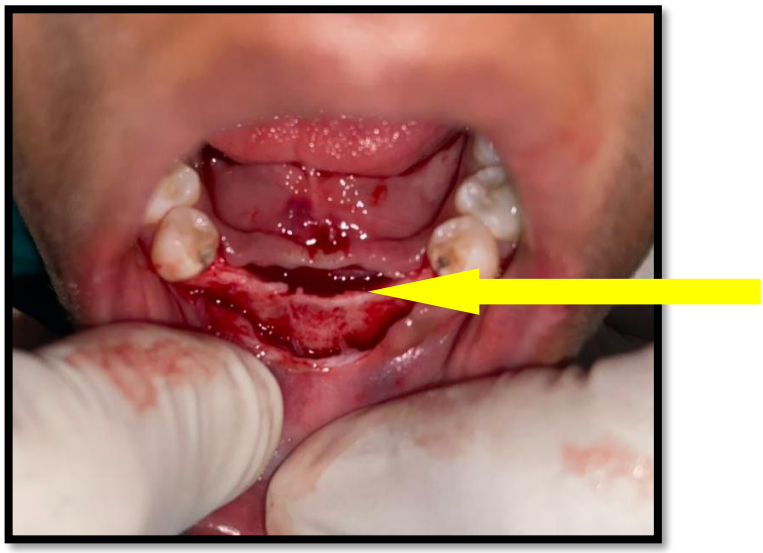


Fig 26: After incision and exposure of site (Kinfe edge ridge)

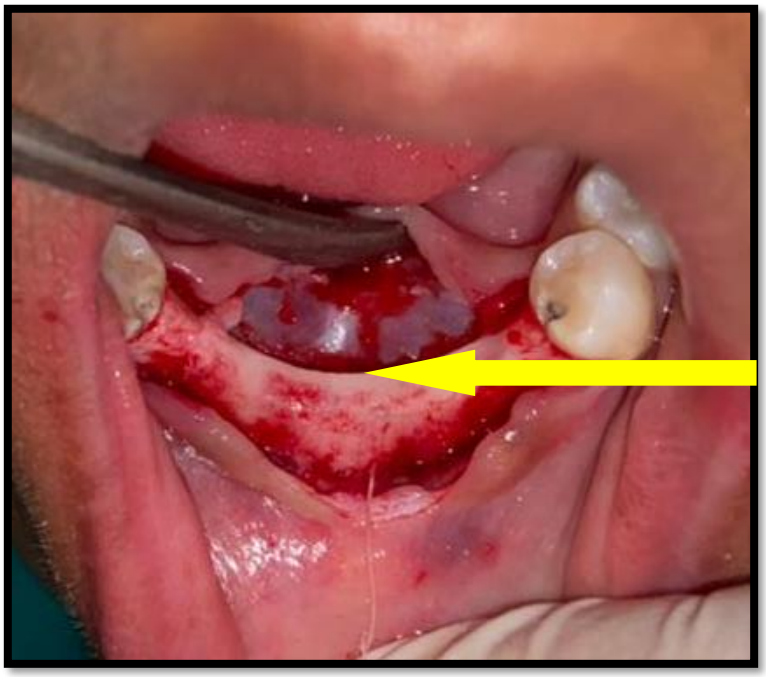


Fig 27: Knife edge ridge was reduced horizontally to achieve a platform for vertical osteotomy

Fig 28: Vertical cut is made to split the ridge to introduce cylindroconical expansion screws

Fig 29: Expansion of ridge with expansion instrument/ Ridge Splitter

Fig 30: Osteotomy done in 33 region with paralleling pin inserted in 43 region

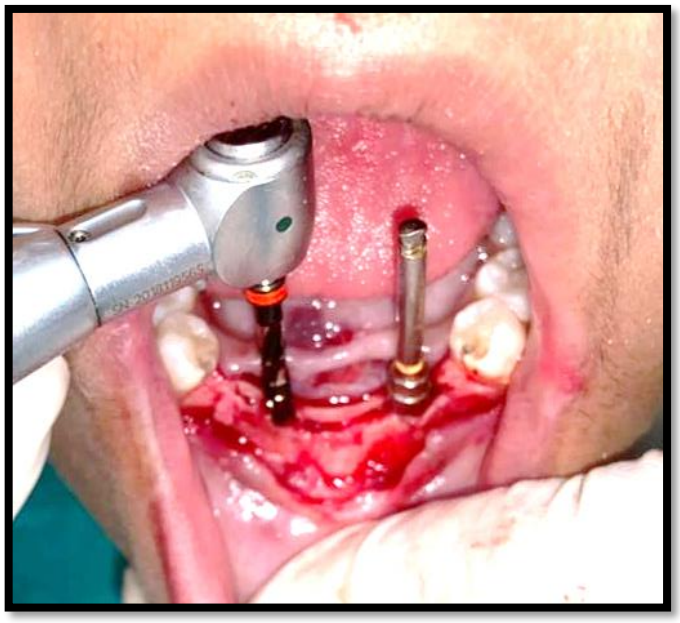


Fig 31: Osteotomy done in 43 region with paralleling pin inserted in 33 region

Fig 32: Osteotomy completed in both regions

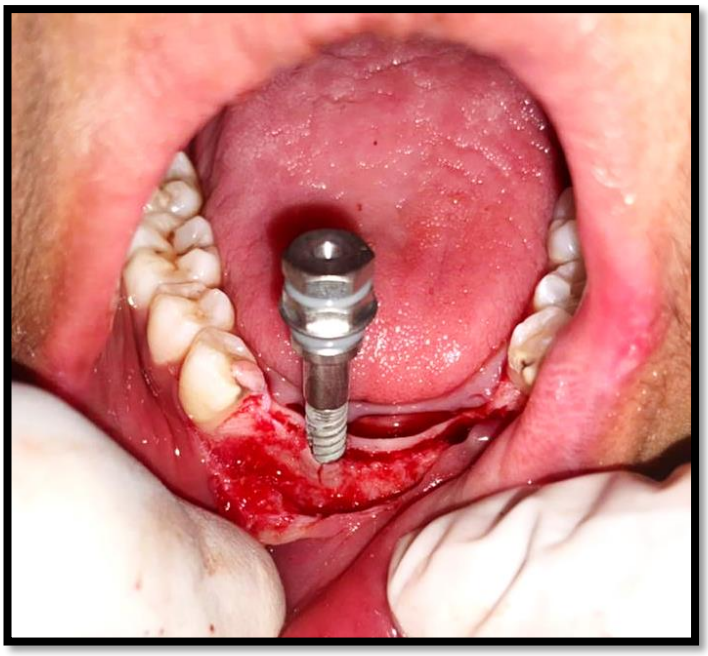


Fig 33: 3.5/10 mm implant loading in 43 Region

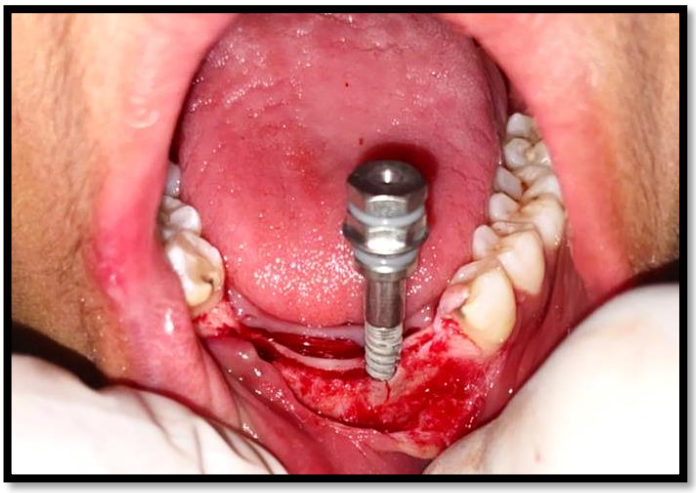


Fig 34: 3.5/10 mm implant loading in 33 region

Fig 35: 3.5/10 mm implant placed in 43, 33

Fig 36: Interrupted suture placed

Post op CBCT after 3 months

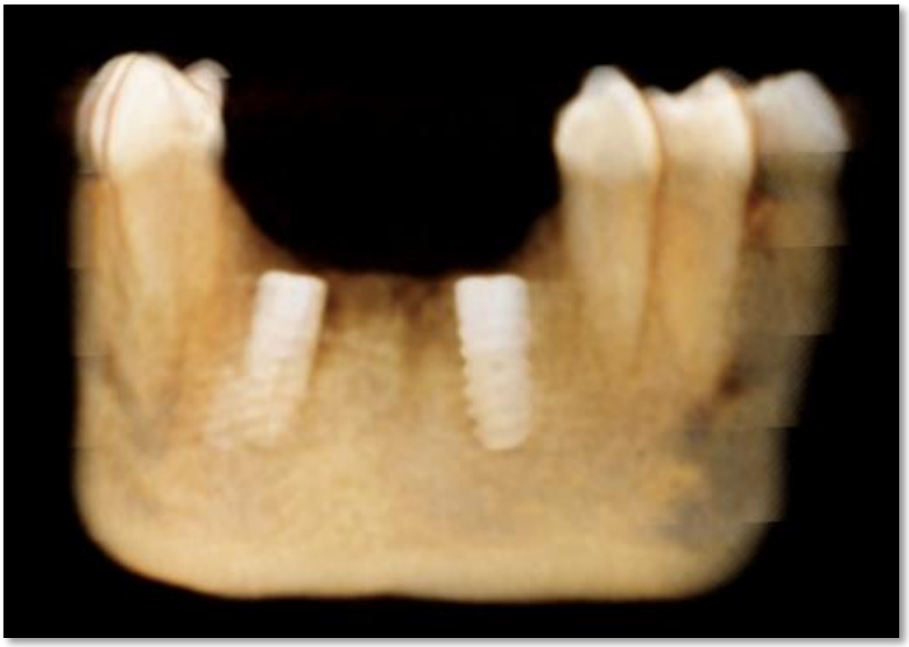


Fig 37: 3d Reconstruction

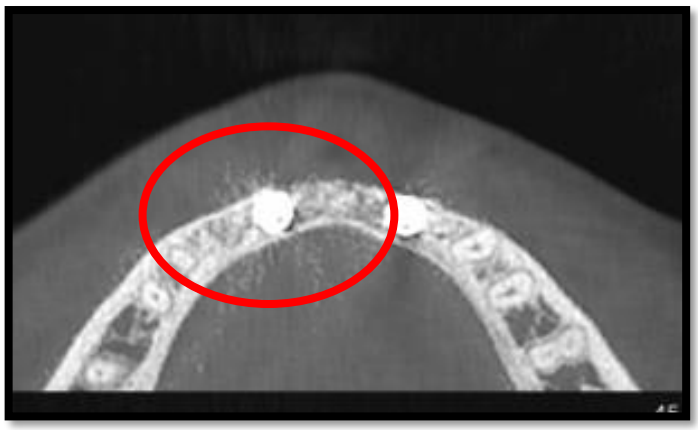


Fig 38: Post op cbct showing implant with expanded lingual and buccal cortical plates

Case 3

Fig 39: Profile Photograph

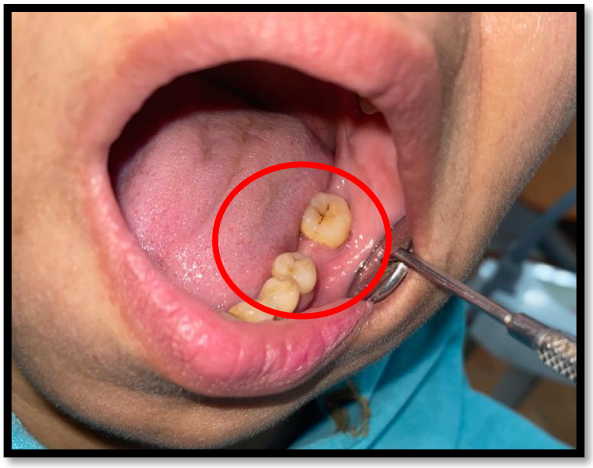


Fig 40: Pre op pictures showing knife edge ridge on 36 edentulous region.

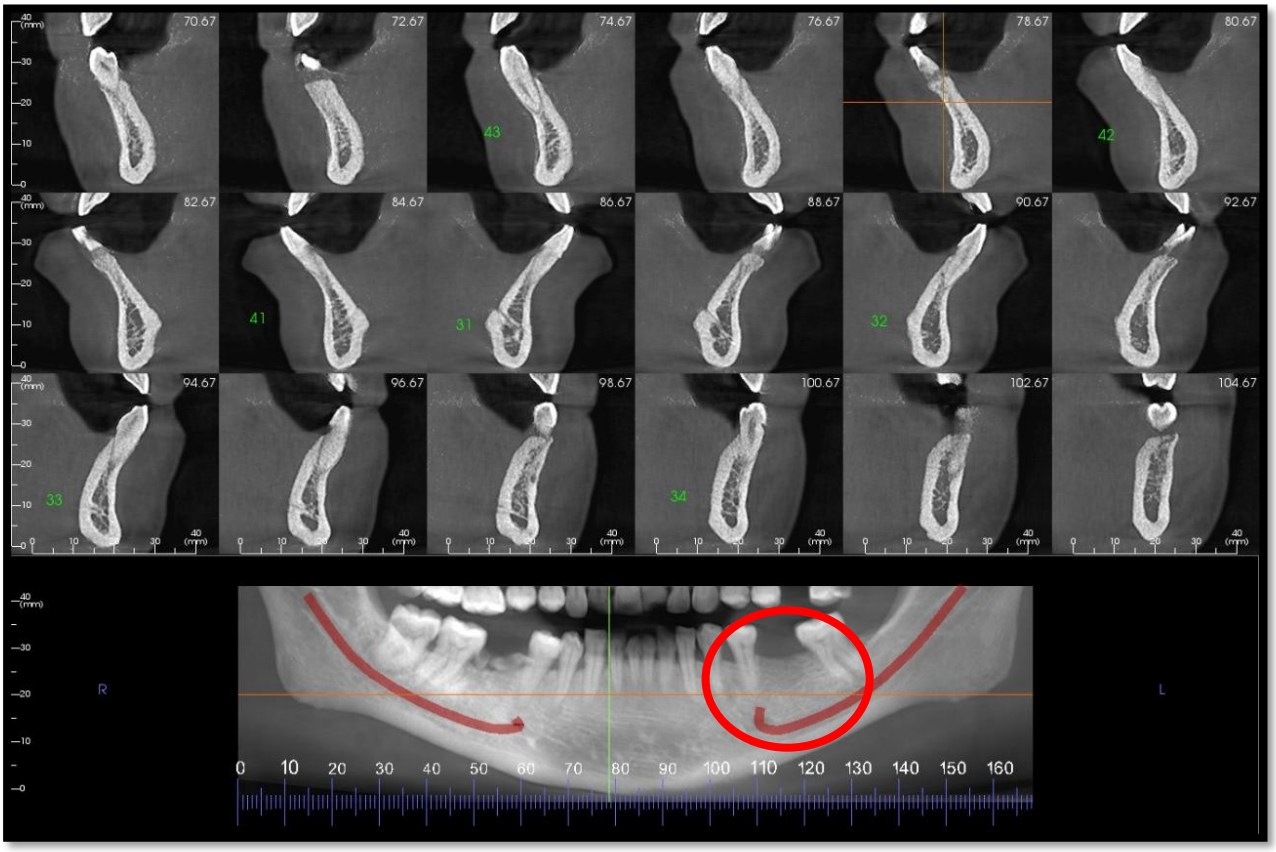


Fig 41: PRE-OP CBCT

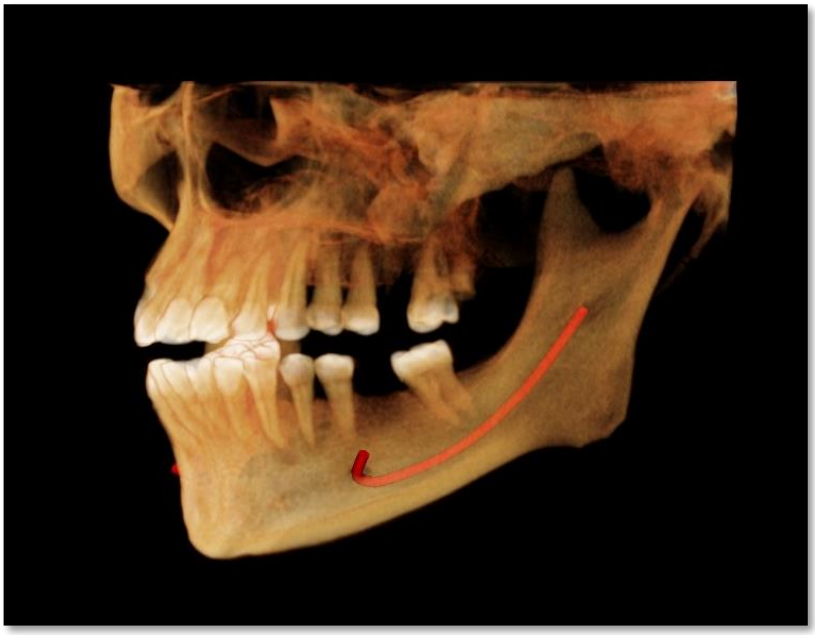


Fig 42: Pre-Op 3D Reconstruction

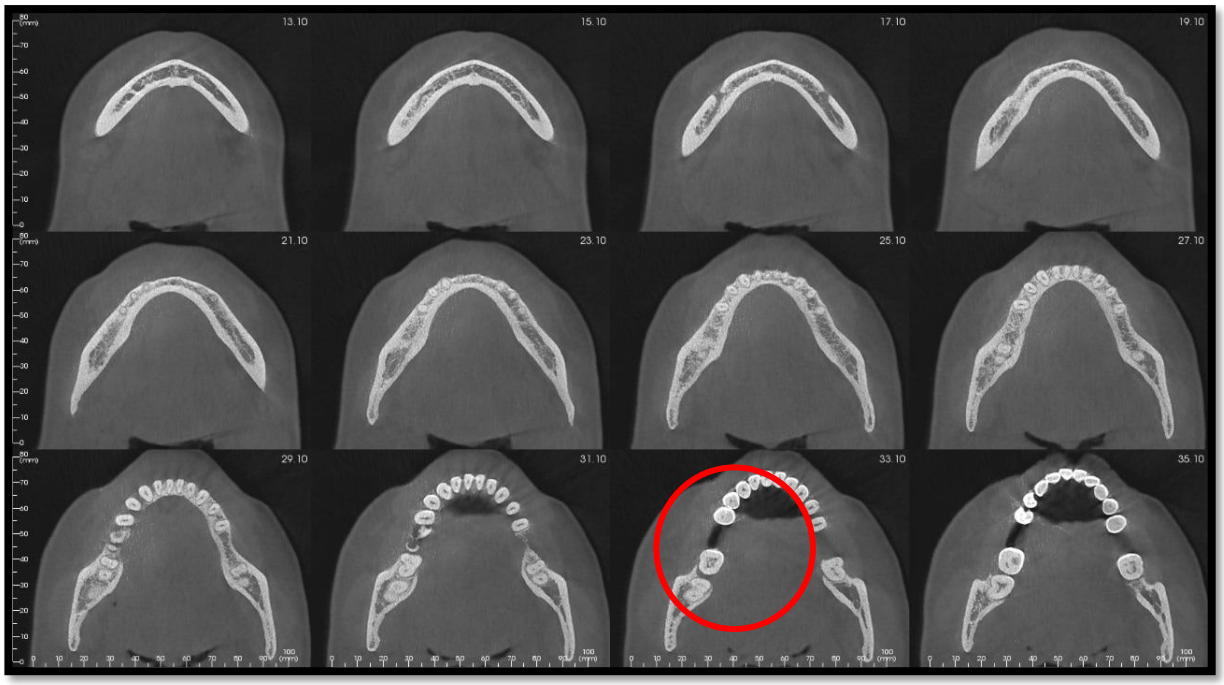


Fig 43: Axial view of pre op CBCT showing implant site with severe bone loss

Intra- OP Photos

Fig 44: Inferior alveolar nerve block was given on site.

Fig 45 : Crestal incision with 15 no BP blade

Fig 46: Mid crestal splitting with Rotary Micro Saw

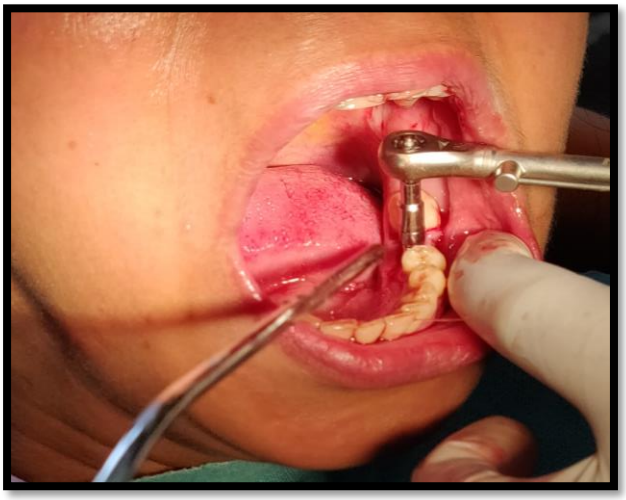


Fig 47: Ridge expansion with expanders

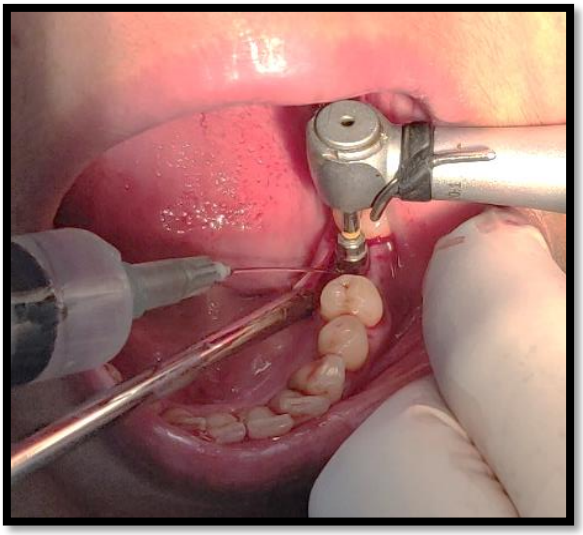


Fig 48: Osteotomy in process irt 36

Fig 49: osteotomy done till 4.2/10 mm

Fig 50: 5/10 mm implant size in position

Fig 51: Implant Placed

Fig 52: Out Fracture Buccal Cortical Bone wrt 36 region

Fig 53: sutures placed in 36 region

Post OP- Pictures

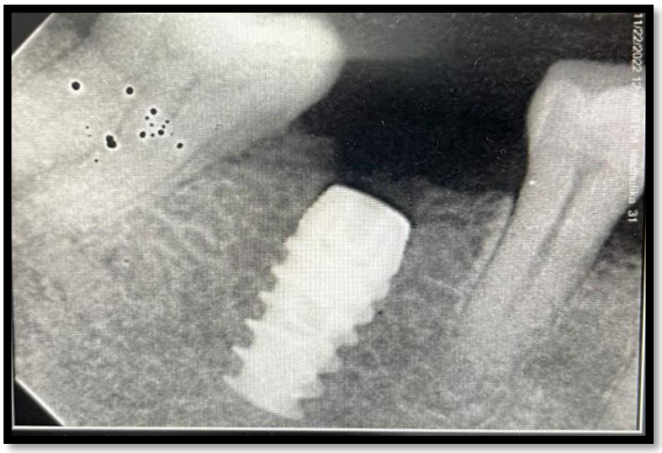


Fig 54: Immediate RVG wrt 36 region after implant placement

Post OP- Pictures after 3 Months

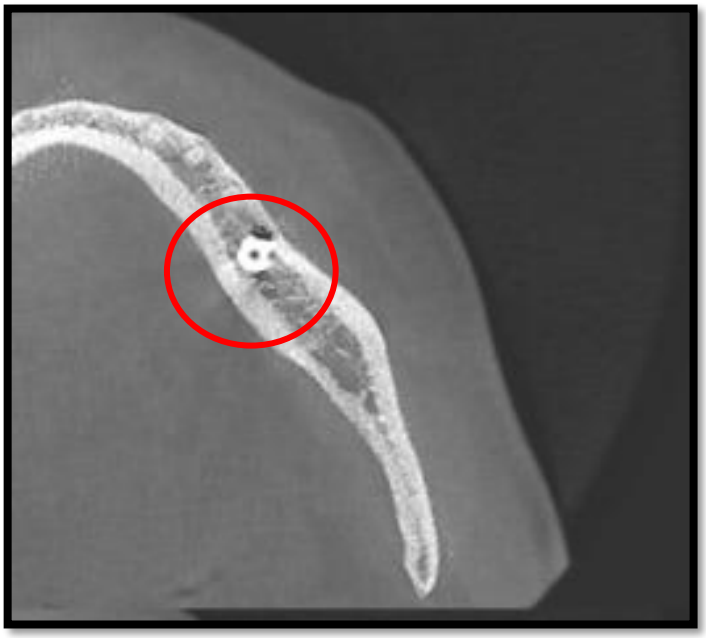


Fig 55: Post OP CBCT after 3 months

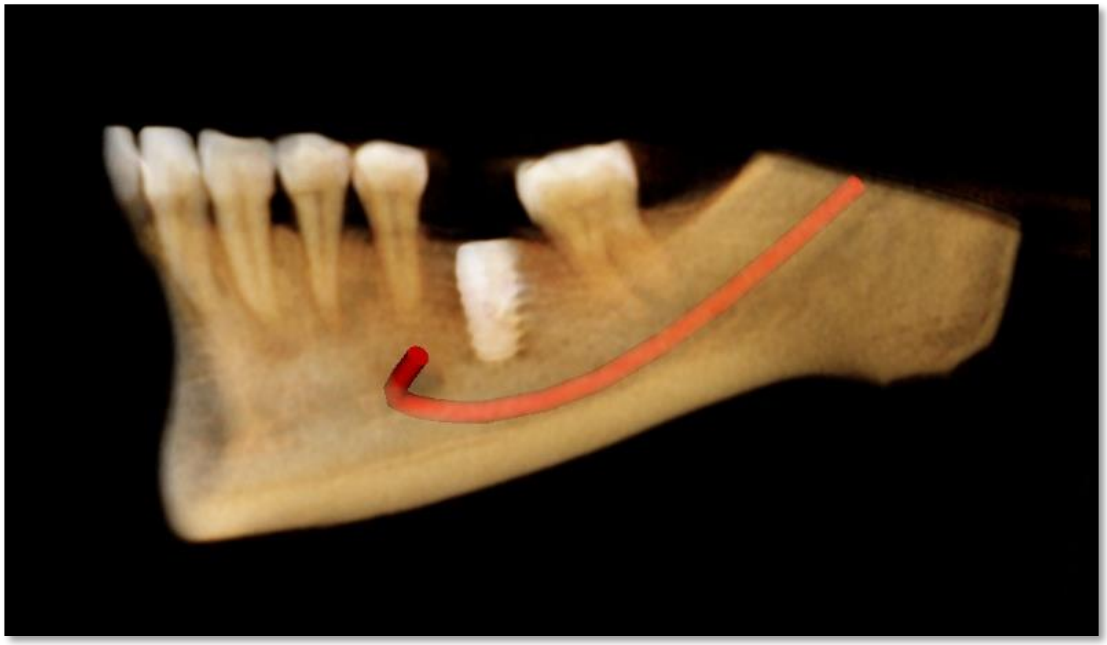


Fig 56: Post OP 3D Reconstruction after 3 months

RESULTS

TABLE 1: DISTRIBUTION OF CASES ACCORDING TO AGE

Age (years)				
gender	**N**	**Mean**	**Std. Deviation**	**P value**
Males	**3**	**25.3333**	**7.57188**	**0.555, NS**
Females	**7**	**29.2857**	**9.79310**	

The study population was comprised of 30% males and 70% females. The mean age of male study participants was 25.33±7.57 years, while of female participants was 29.29±9.79 years. The mean age of male and female study participants was not found to be significantly different.

GRAPH. 1

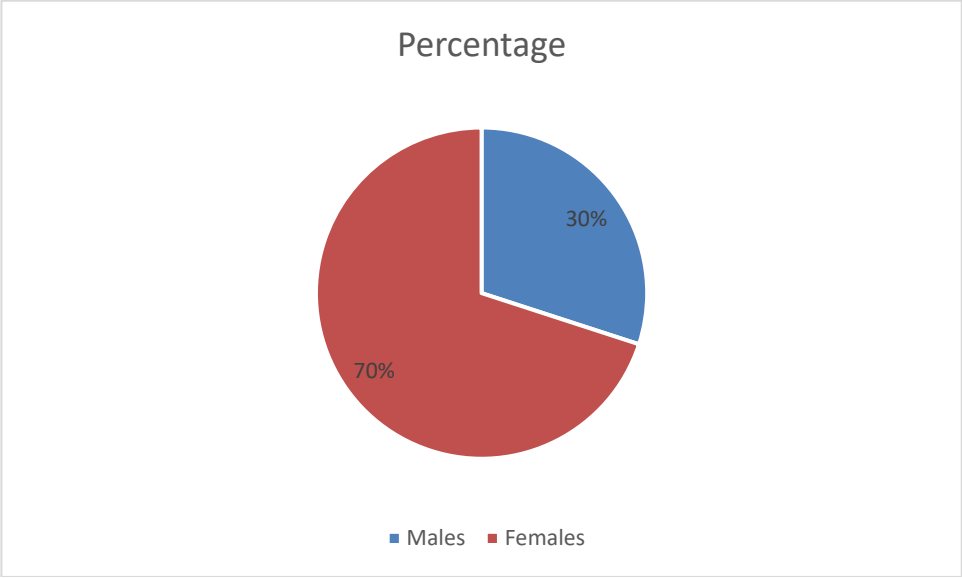


TABLE 2: DISTRIBUTION OF CASES ACCORDING TO CRESTAL RIDGE WIDTH

		Mean	N	Std. Deviation	P value
Crestal Ridge width	**At pre-op**	**3.0640**	**10**	**.39842**	**<0.001, S**
	At post-op	**7.2440**	**10**	**.65425**	

Table 2 showed the intragroup comparison of mean crestal ridge width, which was done using Wilcoxon paired rank sum test. It showed that the mean crestal ridge width increased significantly from pre-op to post-op.

GRAPH. 2

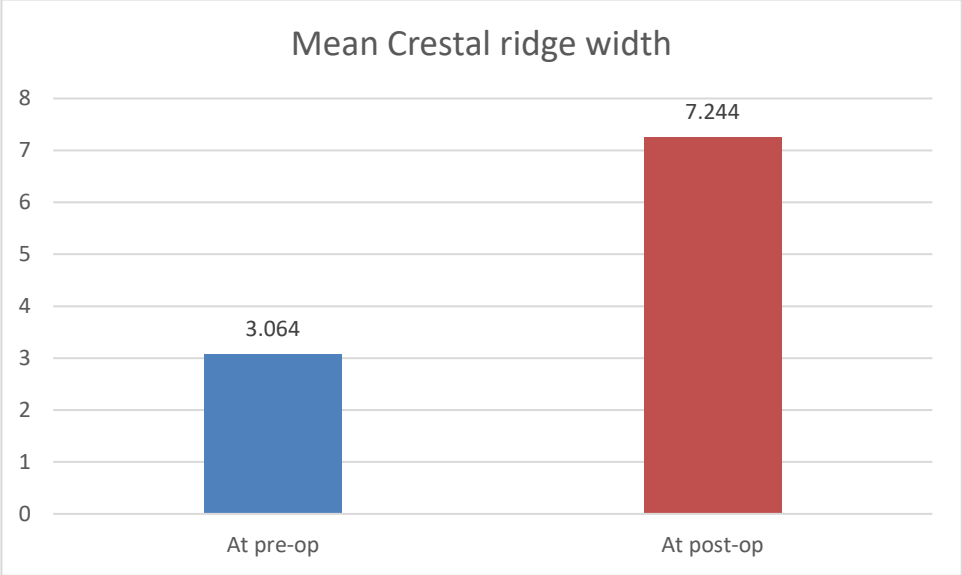


TABLE 3: DISTRIBUTION OF CASES ACCORDING TO STABILITY

		Mean	N	Std. Deviation	P value
Stability	**At the time of surgery**	**71.8000**	**10**	**3.25918**	**<0.001, S**
	At 3 months	**77.8000**	**10**	**2.34758**	

Table 3 showed the intragroup comparison of mean stability, which was done using Wilcoxon paired rank sum test. It showed that the mean stability increased significantly from pre-op to post-op.

GRAPH. 3

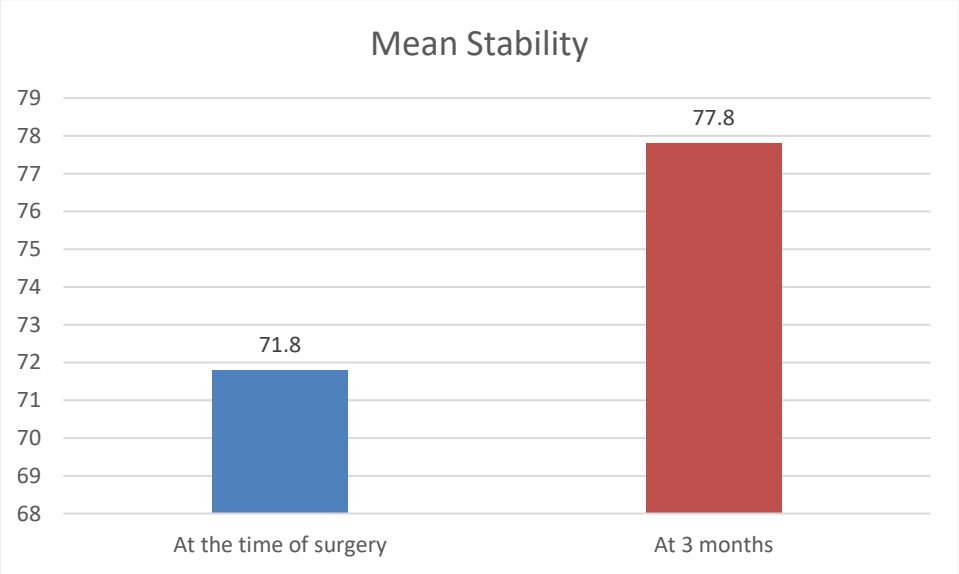


TABLE 4: DISTRIBUTION OF CASES ACCORDING TO CRESTAL BONE LOSS ON MESIAL SIDE

		Mean	N	Std. Deviation	P value
Level of crestal bone Mesial	**Immediately post op**	**1.6500**	**10**	**.24152**	**0.271, NS**
	After 3 months	**1.3700**	**10**	**.81656**	

Table 4 showed the intragroup comparison of mean level of crestal bone on mesial side, which was done using Wilcoxon paired rank sum test. It showed no significant crestal bone loss on mesial side at 3 months post-operatively.

GRAPH. 4

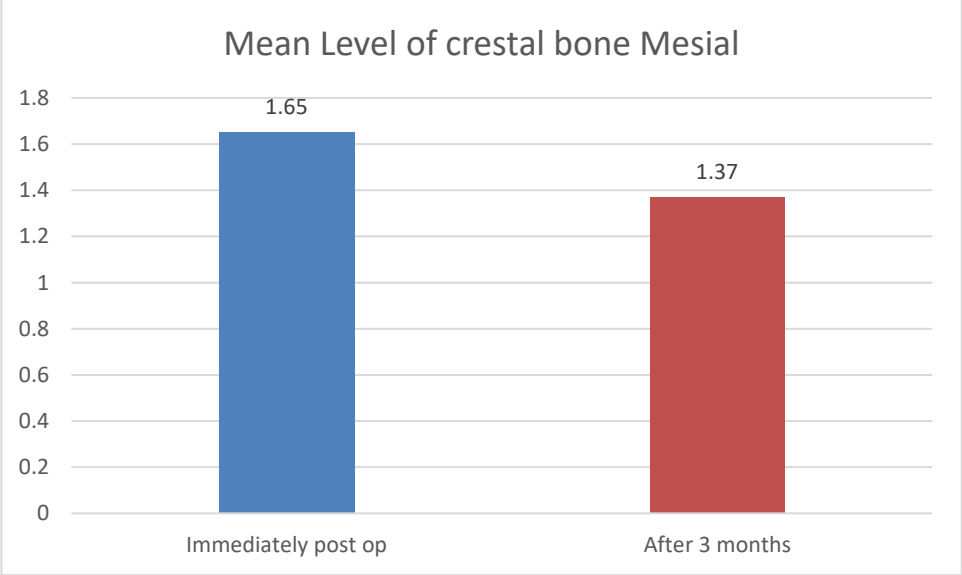


TABLE 5: DISTRIBUTION OF CASES ACCORDING TO CRESTAL BONE LOSS ON DISAL SIDE

		Mean	N	Std. Deviation	P value
Level of crestal bone Distal	**Immediately post op**	**1.0500**	**10**	**.43780**	**0.006, S**
	After 3 months	**.5400**	**10**	**.05164**	

Table 5 showed the intragroup comparison of mean level of crestal bone on distal side, which was done using Wilcoxon paired rank sum test. It showed no significant crestal bone loss on distal side at 3 months post-operatively.

GRAPH. 5

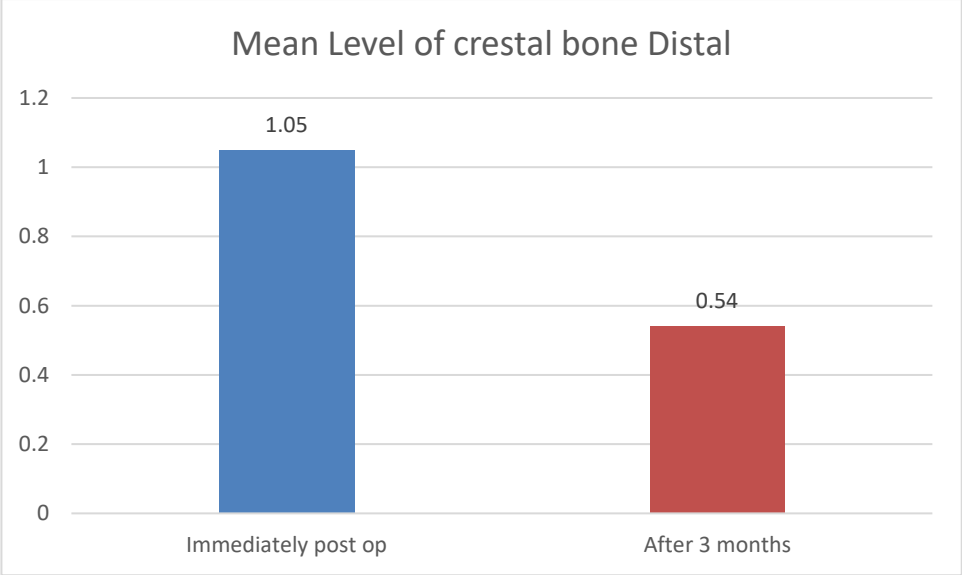
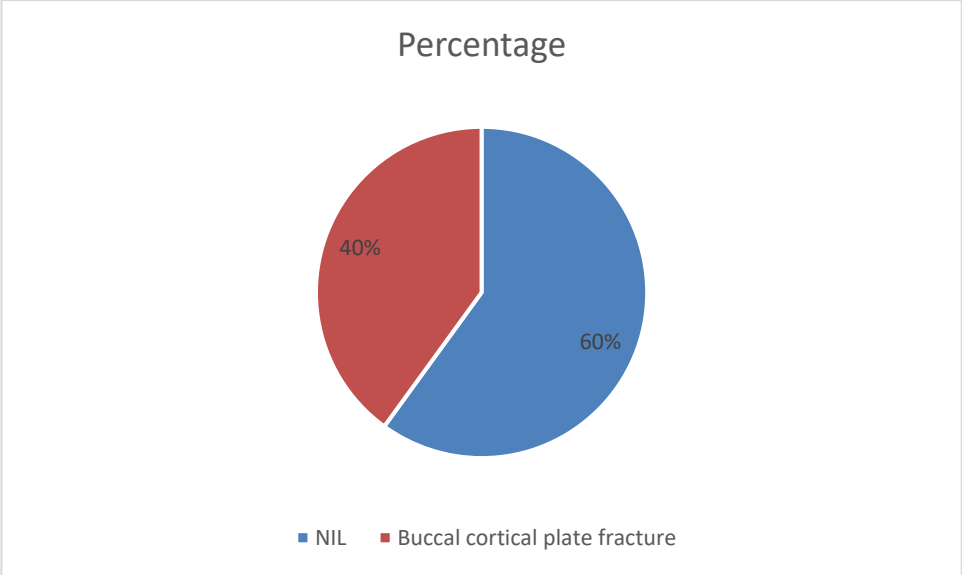


Table 6: DISTRIBUTION OF CASES ACCORDING TO COMPLICATION

Post operative complication		
	N	**%**
NIL	**6**	**60%**
Buccal cortical plate fracture	**4**	**40%**

The frequency of post operative complications was shown to be as 40% and all these cases were of Buccal cortical plate fracture.

GRAPH. 6



DISCUSSION

Dental implants have modernized the profession of dentistry, and rehabilitation of missing teeth with dental implants is deemed to be significantly effective than a conventional fixed prosthesis. It all started in 1950's -1960's with the studies of a Swedish orthopedic surgeon named Professor P. I. Branemark, who hypothesized and created ground-breaking investigations of bone healing and regeneration surrounding implants. This structural and functional connection between the bone and the implant was referred to as "osseointegration" by Professor P. I. Branemark. The primary goal of any implant treatment is to attain long-term stability in addition to functional and structural predictability. It has been stated that the success rate of implants has been increased by altering the implant surfaces, using various surgical procedures, and modifying the bone that requires the implant.

The utmost aim of any implant treatment is to achieve not only a functional and structural predictability and also long-term stability. It's been reported that the success rate of implants was improved by modifying the implant surfaces, by various surgical techniques and by modifying the bone which needs implant. Earlier, Dental Implant placement was done only if there was sufficient height, width and angulation was evident. But, immediately after extraction, there is a rapid loss of alveolar bone either leading to horizontal or vertical ridge deficiency. The field of implant dentistry faced an up-team challenge to provide satisfactory replacement in patients with atrophic alveolar ridges with acceptable results. It is shown in the literature that, of all sites in oral cavity, posterior mandible is referred as difficult site for reconstruction both horizontally and vertically.

Following tooth loss, the most significant feature of the healing process is that the residual bony architecture of the maxilla and mandible undergoes a life-long catabolic remodeling. This results in the formation of a blood clot, clot organization, filling of the socket to the height of the cortical plates with new trabecular bone, and epithelialization over the socket site.[54] In majority of the cases following extraction, resorption and remodeling of the internal trabeculae continues to form high well rounded ridges.[55] But in certain cases further resorption over a wide area of labial surface leads to marked narrowing of the labiolingual diameter of the crest of the ridge, thus forming a knife edge ridge.[56] Especially in the anterior segments of either jaw, a knife-edge shape of the residual ridge is prominent, which is particularly

problematic for implantology since the width of the crest is insufficient for insertion of endosseous implants.

The alveolar bone width should be sufficient to provide minimum 1mm bone width around the implant [57,58]. When the alveolar ridge is narrower than the optimally planned implant diameter, reconstruction of the ridge before implant placement is mandatory. Surgical techniques available to enhance bone volume include bone grafting, guided bone regeneration, and distraction osteogenesis.[59,60,61,62] These methods have several drawbacks including invasive surgical procedures, resorption of grafting materials, membrane collapse, and exposure to infection and delaying of implant installation for grafting maturation.

Expansion of the existing residual ridge is another method to prepare the atrophied ridge for implant insertion. This approach has been referred to as ridge splitting, bone spreading or ridge expansion. The ridge split technique allows the clinician to place implants in anatomic situations involving insufficient bone thickness by moving the external cortical plates of the maxilla/mandible in a labial direction to introduce implants of the appropriate diameter. The ridge can be gradually widened, and there is a reduced risk of the bone segments fracturing. Heat hinders osseointegration, and the expansion technique results in less peri-implant warming of the bone and prevents its loss during expansion.

When the horizontal width of the alveolar ridge is deficient, additional bone augmentation procedures are needed in order to reconstruct the deficient alveolar ridge. The bone augmentation procedure that has been advocated, include guided bone regeneration (Nevins M & Mellonig JT 199261, Hammerle et al 200242) with particulate graft, block grafts (Marx RE et al 199851, Chiapasco M et al 199922) obtained from ramus, symphysis, iliac crest or calvarial bone and ridge split procedure. The major disadvantage of onlay bone grafts are its invasiveness, an additional donor site and resorption of grafted bone. The disadvantages associated with guided bone regeneration are exposure and collapse of the membrane.

The present investigation examined the amount of increase in the B/L ridge width, the ISQ values, marginal bone levels in the maxilla and mandible following the ridge split

technique in 10 patients. The ridge split procedure in combination with implant placement has been described more than 10 years ago. Success and survival rates vary from 92-100%. There are many advantages to this procedure. The intra-oral (ramus, tuberosity, mandibular symphysis) or extra-oral (tibia, iliac crest) harvesting of bone is avoided eliminating a second surgical site thus reducing patient morbidity. Implants placed immediately after the ridge split procedure also reduces patient costs and treatment time.

As previously mentioned, the classic ridge split procedures involved razor sharp bone chisels and rotating or oscillating saws. Bone chisels are impacted into the bone with the use of a mallet, requiring precision and technical skill. We, in our study, used rotary instruments for the ridge split procedure. Although, rotating or oscillating saws are dangerous to both bone and soft tissue, the risk of soft tissue injury was significantly reduced when used cautiously and any shape/design of the bone incision could be easily performed without danger to the adjacent structures.

It must be noted that only the buccal cortical plate of the maxilla/mandible is moved in a labial direction during the ridge expansion utilizing bone chisels and osteotomes. The lingual and palatal cortical plates are not weakened by the expansion due to their being stronger. The cortices determine the direction of the labial aspect as it is the path of least resistance.

The study included 10 patients, 7 females and 3 males. The average age was 28.1 years. There was a total of 13 dental implants placed immediately after the ridge split procedures, patients were selected with inadequate alveolar bone width between 3 to 5 mm with adequate alveolar bone height. The criterion used for implant placement is at least 1mm bone around the implant site. Present study was conducted to effectively maintain 1mm surrounding bone in patients with inadequate ridge width. The implants placed were evaluated both clinically and radiographically based on the criteria suggested by Misch et al at The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference.[63] The Clinical evaluation included pain and clinical mobility while radiographic evaluation included crestal bone width analyzed using CBCT preoperatively and 6th month post-operatively.

An evidence-based review of literature shows that the alveolar bone density, bone width and height can be measured accurately by CBCT.[64] CBCT was used in this study to assess preoperative ridge width and post operative ridge width for all the patients. CBCT was done pre-operatively and after 6 months. Average pre-op ridge width of alveolar crest recorded on CBCT was 3.26 mm, with minimum being 2.56 mm and maximum being 3.56 mm. Post op ridge width on CBCT at post 6 months was found to be mean of 7.24 with minimum being 6.67 mm and maximum being 8.2mm.
The difference in ridge width was statistically analyzed by Wilcoxon paired rank sum test which was statistically significant (p value <0.001). The difference in pre-op and post 6 month's ridge width was also analyzed in same manner which is also significant (p value <0.001).

The mean total gain in ridge width immediately following the ridge split procedure was 3.26 mm in this investigation. This increase in width correlates well with other published studies. Blus et al[65] performed the RST with immediate placement in both maxillary and mandibular sites. Two hundred thirty implants were reported with an increase in bone width ranging from 2.5 – 4.0 mm. This study also correlates well with the study done by Agabiti I et al (2017)[66], where in the mean initial width of the alveolar bone crest measured 4.1±0.5mm, reaching 6.8mm± 0.9mm after ridge expansion.

The initial few months following implant placement are regarded as an active phase of bone loss, however this period has not been thoroughly researched. According to Adell R et al (1981)[67], due to the surgical trauma, elevation of the periosteum, or stress concentration from the considerable tightening of the implant could all be contributing factors to this rapid initial bone loss. Therefore, in our investigation, radiographic evaluation of the marginal bone dimension surrounding implants placed by ridge splitting has been performed both immediately after implant insertion and three months later.

In this study, in test sites amount of radiographic bone loss increased from 1.50 mm to 2.00 mm after 3 months in mesial sites and from 1.00 mm to 2.0 mm in distal sites respectively. The mean values of recorded bone loss around mesial aspects of implants immediately after their placement and after 3 months among test and control sites was

not statistically significant which is similar to the studies reported by Bruschi GB (2017)[68] and Nandal S (2014), however, in our study, the mean level of crestal bone on distal side decreased significantly from immediately post-op to 3 months post op which was statistically significant. (p 0.006)

High implant stability (ISQ) can be attained, according to studies on rotary implant site preparation published by Stacchi C et al (2011)[69] and da Silva Neto UT et al (2014). Within the constraints of the current investigation, greater ISQ values were observed at the rotary instrument-treated sites, although this difference was not statistically significant. This might have occurred due to the small sample size and short-term follow-up.

According to the findings of the present study, insertion of an implant at the same time as ridge expansion using bone expanders is an effective procedure for treating narrow, atrophic ridges. It also offers a considerable advantage over other bone grafting and invasive traumatic procedures. It also offers advantages including reduced treatment periods, no comorbidities from the secondary donor site, controlled bone growth without fracture, immediate implant placement in narrow ridges during expansion, versatility for both the maxilla and the mandible, cost effectiveness, and no requirement for bone barriers or bone graft material.

The main surgical risk of the ridge split procedure is the fracture of the labial cortical plate. Sohn DS et al (2010)[70], Shiak LS et al (2016)[71] also reported fracture of buccal plates during ridge split procedure.

In this study during the surgical procedure, minor fracture of buccal plate occurred in 4 of the 10 sites (40%) and in the fractured site decortication of buccal plate was done. bone graft was placed on the fracture line and covered with resorbable collagen membrane, which healed uneventfully. No patients exhibited partial membrane exposure and flap dehiscence at the 10- day post-operative follow up There was no exposure of cover screw in the implant sites during the first month of post-operative period.

In summary, to assess the effectiveness of the rotary instruments and to comprehend the healing and production of bone around implants following ridge split procedure, further clinical and histological investigations with a high sample size and long-term follow up are the paramount. The fractured buccal cortical plate eventually heals by itself when covered with periosteum.

CONCLUSION

The aim of the current study was to assess the changes in implant stability, bucco-lingual width of the alveolar ridge, and marginal bone level following ridge splitting with implant insertion utilizing traditional rotary instruments.

Ridge split technique enables immediate implant placement which reduces the treatment time. Ridge split can be done by using traditional instruments like chisels, mallet and rotary instruments. However, rotary instruments are very efficient in bone cutting; it has some disadvantages like soft tissue lacerations, loss of fine touch sensitivity and thermal injury. Overheating of adjacent tissues may alter or delay the healing response. These complications can be overcome by using ultrasonic device.

The study included 10 patients, 7 females and 3 males. There were a total of 13 dental implants placed immediately after the ridge split procedures, patients were selected with inadequate alveolar bone width between 3 to 5mm with adequate alveolar bone height. Following surgery, all patients underwent periodic examinations at 7 days, 1 month, and 3 months.

In our study, some complications were also observed where the increased bone resorption and early complications around 4/10 implants in this study could be due to a number of factors of which include:
(i) clinician inexperience,
(ii) reduced overall blood supply to the surgical site,
(iii) surgical trauma,
(iv) patient factors.

10/10 implants (100%) were Osseo integrated and were available for follow- up upto 6 months after loading and exhibited no further changes in marginal bone levels or soft tissue peri-implant parameters.

On the basis of this study, it can be stated that;

- The enhancement in implant stability, alterations in marginal bone level, and bucco-lingual ridge width obtained in this study correlated well with other studies.

- There was an increase in ISQ values with rotary treated sites. The amount of implant stability obtained improved the survival rate of implants and met with the expectations and demands of the patients and also the treating surgeon.
- There was an increase in bucco-lingual width in 3 months in the treated sites which was statistically significant.

The results of this study confirm the efficacy of rotary devices in implant site osteotomies. The following should be taken into consideration when interpreting the results within the constraints of the study:

• Relatively small sample size (n=10)

• Short follow-up period

Overall conclusion from this study is that predictable success can be achieved with simultaneous implant placement following ridge split technique. This technique enables the substitution of more invasive and time-consuming bone-grafting techniques. Additionally, it can be concluded that this technique is minimally invasive, economical, and predictable when used with the plethora of commercially available implants and a successful surgical and prosthetic outcome entails careful patient assessment and case selection.

BIBLIOGRAPHY

1. Misch CE: Contemporary implant dentistry, St.Louis, 2008, Elsevier.

2. Brånemark PI, Hansson BO, Adell R, Breine U, Lindstrom J, Hallen O, Ohmann A. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. Scand J Plast Reconstr Surg 1977; 16:1-132.

3. Allen F, Smith DG. An assessment of the accuracy of ridge mapping in planning implant therapy for the anterior maxilla. Clin Oral Implants Res 2000 Feb: 11(1):34-38.

4. Chiapasco M, Romeo E, Vogel G. Vertical distraction osteogenesis of edentulous ridges for improvement of oral implant positioning: a clinical report of preliminary results. Int J Oral Maxillofac Implants 2001; 16(1):43-51.

5. Friberg B, Sennerby L, Linden B, Grondahl K, Lekholm U. stability measurements of one stage Branemark implants during healing in mandibles. A clinical resonance frequency analysis study. Int J Oral Maxillofac surg 1999; 28:266-72.

6. Meredith N, Alleyne D, Cawley P. Quantitative determination of the stability of the implant tissue interface using resonance frequency analysis. Clin Oral Implants Res 1996; 7:261-266.

7. Raghavendra S, Wood MC, Taylor TD. Early wound healing around endosseous implants: a review of the literature. Int J Oral Maxillofac Implants 2005; 20:425–431.

8. Chiapasco M, Ferrini F, Casentini P, Accardi S, Zaniboni M. Dental implants placed in expanded narrow edentulous ridges with the Extension Crest device. A 1-3-year multicenter follow-up study. Clin Oral Implants Res. 2006 Jun;17(3):265-72.

9. Reich KM, Huber CD et al. Atrophy of residual alveolar ridge following tooth loss in an historical population. Oral Diseases 2010;17(1):1-26

10. Guirado JL,yuguero MR,Carrion del Valle MJ, Zamora GP. A maxillary ridgesplitting
technique followed by immediate placement of implants: a case report.Implant Dent 2005;14:14-20.

11. Abuelroos E, Shokier H. Management of Severely Resorbed Ridge Using Ridge Splitting Techniques with Simultaneous Implantation. Cairo Dental Journal (25) 2009; (1): 97-103

12. Schropp LI, Wenzel A, Kostopoulos L,Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. Int J Periodontics Restorative Dent .2003 Aug; 23(4):313-23.

13. Arora V, Kumar D, Alveolar ridge split technique for implant placement, Medical Journal Armed Forces India 2014 (12):13.

14. Young-Kyun Kim and Su-gwan Kim Horizontal Ridge Expansion and Implant Placement Using Screws: A Report of Two Cases. J Korean Assoc Oral Maxillofac Surg.2014Oct;40(5):233-239.

15. Demarosi F, Leghissa GC, Sardella A, Lodi G, Carrassi A. Localized ridge expansion with simultaneous implant placement: A case series. Br J Oral maxillofac Surg.2009;47(7);535-40.

16. Cortes AR, Cortes DN. Non traumatic bone expansion for immediate dental implant placement:An analysis of 21 cases.Implant Dent.2010;19(2)92-97.

17. Vercellotti T. Piezoelectric surgery in Implantology: A case report – A new piezoelectric ridge expansion technique. Int J Periodontics Restorative Dent. 2000;20: 359-365.

18. Coatoam GW, Mariotti A. The segmental ridge split procedure. J Periodontol. 2003;74:757–770.

19. Kheur M, Gokhale S, Sumanth S, Jambekar S. Staged ridge splitting technique for horizontal expansion in mandible: a case report. J Oral Implantol. 2014 Aug;40(4):479-83.

20. Misch C ;Implant Site Development Using Ridge Splitting Techniques. Oral Maxillofacial Surg Clin N Am 16(2004) 65-74.

21. Basa S, Varol A, Turker N. Alternative bone expansion technique for immediate placement of implants in the edentulous posterior mandibular ridge: a clinical report. Int J Oral Maxillofac Implants. 2004 Jul-Aug;19(4):554-8.

22. Arun Garg (2009). Maxillary Ridge Splitting: A New Approach. Dental Implantology Update. The International Forum for Continuing Education Dec 2009 20(12).

23. Holtzclaw DJ, Toscano NJ, Rosen PS. Reconstruction of posterior mandibular alveolar ridge deficiencies with the piezoelectric hinge-assisted ridge split technique: a retrospective observational report. J Periodontol. 2010 Nov;81(11):1580-6.

24. Gonza´lez-Garcı´a, R. et al., Alveolar split osteotomy for the treatment of the severe narrow ridge maxillary atrophy: a modified technique, Int J Oral Maxillofac Surg(2010), doi:10.1016/j.ijom.2010.03.030

25. Sohn DS, Lee HJ, Heo JU, Moon JW, Park IS, Romanos GE. Immediate and delayed lateral ridge expansion technique in the atrophic posterior mandibular ridge. J Oral Maxillofac Surg. 2010 Sep;68(9):2283-90.

26. Sakamoto, Y. et al. The conservative surgical strategy for insufficient alveolar ridge employing split crest and socket lift procedure. International Journal of Oral and Maxillofacial Surgery, 40(10); 1047.

27. Len Tolstunov, Bruce Hicke; Horizontal Augmentation Through the Ridge-Split Procedure: A Predictable Surgical Modality in Implant Reconstruction. *J Oral Implantol* 1 February 2013; 39 (1): 59–68.

28. Book: Ridge Augmentation Procedures in Implant Patients: A Staged Approach. By Luca Cordaro, Hendrik Terheyden.

29. Khairnar MS, Khairnar D, Bakshi K. Modified ridge splitting and bone expansion osteotomy for placement of dental implant in esthetic zone. Contemp Clin Dent. 2014 Jan;5(1):110-4.

30. Ioannis Papathanasiou1, GeorgiosVasilakos2, Sotirios Baltiras2, Lampros Zouloumis3. Ridge Splitting Technique for Horizontal Augmentation and Immediate Implant Placement. CASE REPORT (CR) Balk J Dent Med, 2014; 18:41-47.

31. Ella B, Laurentjoye M, Sedarat C, Coutant JC, Masson E, Rouas A. Mandibular ridge expansion using a horizontal bone-splitting technique and synthetic bone substitute: an alternative to bone block grafting? Int J Oral Maxillofac Implants. 2014 Jan-Feb;29(1):135-40.

32. Arora V, Kumar D. Alveolar ridge split technique for implant placement. Med J Armed Forces India. 2015 Dec;71(Suppl 2): S496-8.

33. Misch CM. Implant site development using ridge splitting techniques. Oral Maxillofac Surg Clin North Am. 2004 Feb;16(1):65-74.

34. Len Tolstunov. Classification of the Alveolar Ridge Width: Implant Driven Treatment Considerations for the Horizontally-Deficient Alveolar Ridges," Journal of Oral Implantology, Vol. 40, Special Issue 1, 2014.

35. Elnayef B, Monje A, Lin GH, Gargallo-Albiol J, Chan HL, Wang HL, Hernández-Alfaro F. Alveolar ridge split on horizontal bone augmentation: a systematic review. Int J Oral Maxillofac Implants. 2015 May-Jun;30(3):596-606.

36. Mechery R, Thiruvalluvan N, Sreehari AK. Ridge split and implant placement in deficient alveolar ridge: Case report and an update. Contemp Clin Dent. 2015 Jan-Mar;6(1):94-7.

37. Udatta Kher. Ridge Split Procedure in the Atrophic Maxilla. SPECTRUM Dental Teamwork Vol.8 No.2 - February/March 2015.

38. Waechter J, Leite FR, Nascimento GG, Carmo Filho LC, Faot F. The Split crest technique and dental implants: a systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2017 Jan;46(1):116-128.

39. Dr. Quaid Johar Shakir, Namrata Dattatraya Pailwan and Dipti Udaysing Patil. 2016. "Maxillary ridge expansion followed by immediate implant placement: A clinical case report", International Journal of Current Research, 8, (02), 26223-26226.

40. Amr Zahran et al. A Modified Split-Crest Technique using Piezoelectric Surgery and Immediate Implant Placement in the Atrophic Maxilla.The Journal of Implant & Advanced Clinical Dentistry:8(4); July/August 2016.

41. Juan Reyes Doimi, Guillermo Mauricio Aguirre Balseca, Andreé Cáceres La Torre, Placement of dental implants in atrophic jaw with divided crest and ridge expansion technique, Revista Odontológica Mexicana, 21(3), 2017; e192-e198.

42. Moro A, Gasparini G, Foresta E, Saponaro G, Falchi M, Cardarelli L, De Angelis P, Forcione M, Garagiola U, D'Amato G, Pelo S. Alveolar Ridge Split Technique Using Piezosurgery with Specially Designed Tips. Biomed Res Int. 2017; 2017:4530378.

43. Parthiban PS, Lakshmi RV, Mahendra J, Sreekumar K, Namasivayam A. A contemporary approach for treatment planning of horizontally resorbed alveolar ridge: Ridge split technique with simultaneous implant placement using platelet rich fibrin membrane application in mandibular anterior region. Indian J Dent Res. 2017 Jan-Feb;28(1):109-113.

44. Delai et al. – Split crest technique: a solution for atrophic anterior maxilla – case report. – RSBO. 2017 Oct-Dec;14(4):244-9.

45. Al Ali Rammal., et al. "Modified Staged Ridge Splitting Technique Versus Conventional Technique for Horizontal Expansion of Narrow Posterior Mandible (Randomized Controlled Clinical Trial)". Acta Scientific Dental Sciences 2.7 (2018): 101-109.

46. Karan NB, Akinci HO. A Novel Approach for Horizontal Augmentation of Posterior Maxilla Using Ridge Split Technique. J Craniofac Surg. 2019 Jul;30(5): 1584-1588.

47. Houssam Abou Hamdan, Talal Salame. Split-crest and immediate implant placement an Alternative Technique for Implant Placement in Atrophic Edentulous Maxilla and Mandible: 5-year follow-up of 160 treated implant sites. NNO-Implant-System_Split-crest-and-immediate-implant-placement. 2016.

48. Soni R, Priya A, Yadav H, Mishra N, Kumar L. Bone augmentation with sticky bone and platelet-rich fibrin by ridge-split technique and nasal floor engagement for immediate loading of dental implant after extracting impacted canine. Natl J Maxillofac Surg. 2019 Jan-Jun;10(1):98-101.

49. Starch-Jensen T, Becktor JP. Maxillary Alveolar Ridge Expansion with Split-Crest Technique Compared with Lateral Ridge Augmentation with Autogenous Bone Block Graft: a Systematic Review. J Oral Maxillofac Res. 2019 Dec 30;10(4):e2.

50. Kumar, I., Singh, H., Arora, S.S., Singh, A. and Kumar, N. (2019), Implant placement in conjunction with ridge split and expansion technique. Oral Surg, 12: 214-223.

51. Dr. Yoginder Singla, Dr. Rajni Sharma. Implant placement in narrow alveolar ridge with ridge split technique: A new approach in implant placement. Int J Appl Dent Sci 2020;6(4):448-451.

52. Al-Hamdan K, Alaqeely R, Gamal A. A. Managing Atrophic Maxilla Using Ridge-Split Technique: a Review Based Analysis with two case Reports. Biosc.Biotech.Res.Comm. 2021;14(1).

53. Goyal M, Mittal N, Gupta GK, Singhal M. Ridge augmentation in implant dentistry. J Int Clin Dent Res Organ 2015;7, Suppl S1:94-112.

54. Scipioni A, Bruschi GB, Giargia M, et al. Healing at implants with and without primary bone contact. Clin Oral Impl Res 1997; 8:39– 47.

55. Tan WL, Wong TL, Wong MC, Lang NP. A systemic review of post-extractinal alveolar hard and soft tissue dimensional changes in humans. Clin Oral Implant Res. 2012 feb; 23 suppl 5:1-21.

56. Reich KM, Huber CD et al. Atrophy of residual alveolar ridge following tooth loss in an historical population. Oral Diseases 2010;17(1):1-26.

57. Guirado JL,yuguero MR,Carrion del Valle MJ, Zamora GP. A maxillary ridgesplitting technique followed by immediate placement of implants: a case report.Implant Dent 2005;14:14-20.

58. Tatum H. Maxillary and sinus implant reconstructions.Dent Clin N Am 1986;30:207– 29.

59. Guirado JL,yuguero MR,Carrion del Valle MJ, Zamora GP. A maxillary ridgesplitting technique followed by immediate placement of implants: a case report.Implant Dent 2005;14:14-20.

60. Abuelroos E , Shokier H . Management of Severely Resorbed Ridge Using Ridge Splitting Techniques with Simultaneous Implantation. Cairo Dental Journal (25) 2009; (1): 97-103.

61. Gonza´lez-Garcı´a, R. et al., Alveolar split osteotomy for the treatment of the severe narrow ridge maxillary atrophy: a modified technique, Int J Oral Maxillofac Surg (2010), doi: 10.1016/j.ijom.2010.03.030.

62. Sethi N, Singh R , Sethi S, Krishna P. Ridge-Splitting Technique In Mandible With Simultaneous Implant Placement - A Case Report. Indian Journal of Dental Sciences.2012;4(4):90-92.

63. Misch C, Perel M, Wang HL et al. Implant success,survival, and failure: The International Congress of Oral Implantologists(ICOI) Pisa Consensus Conference. Implant Dent 2008;17(1):5-9.

64. N Ibrahim,A Parsa,B Hassan, P Vander Telt and D Wismeijer.Diagnostic Imaging Of Trabecular Bone Microstructure For Implants: A Literature review .Dentomaxillfac Radiol.2013 Mar;42(3).

65. Blus C, Szmukler-Moncler S, Khoury P, Orrù G. Immediate im- plants laced in infected and noninfected sites after atraumatic tooth extraction and placement with ultrasonic bone surgery. Clin Implant Dent Relat Res. 2015;17:e287-97.

66. Agabiti I, Botticelli D. Two-Stage Ridge Split at Narrow Alveolar Mandibular Bone Ridges. J Oral and Maxillofac Surg 2017; 75(10):2115.e1- 2115.e12.

67. Adell R, Lekholm U, Rockler B, Branemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg 1981; 10:387-416.

68. Bruschi GB, Cappare P, Bravi F, Grande N, Gherlone E, Gastaldi G, Crespi R. Radiographic Evaluation of Crestal Bone Level in Split-Crest and Immediate Implant Placement: Minimum 5-Year Follow-up. Int J Oral Maxillofac Implants 2017; 32(1):114-120.

69. Stacchi C, Vercellotti T, Torelli L, Furlan F, Di Lenarda R. Changes in Implant Stability Using Different Site Preparation Techniques: Twist Drills versus Piezosurgery. A Single-Blinded, Randomized Controlled Clinical Trial. Clin Implant Dent Relat Res 2011; 1-10.

70. Sohn DS, Lee HJ, Heo JU, Moon JW, Park IS, Romanos GE. Immediate and delayed lateral ridge expansion technique in the atrophic posterior mandibular ridge. J Oral Maxillofac Surg 2010; 68:2283-2290.

71. Stacchi C, Vercellotti T, Torelli L, Furlan F, Di Lenarda R. Preparation Techniques: Twist Drills versus Piezo-surgery. A Single-Blinded, Randomized, Controlled Clinical Trial. Clin Implant Dent Relat Res 2013; 15:188-97.

ANNEXURES

Plagiarism report

Ouriginal

Document Information

Analyzed document	Efficacy of Ridge Split Technique in Horizontal Alveolar Ridge Augmentation for Implant Placement Thesis.docx (D158027496)
Submitted	2023-02-07 10:54:00
Submitted by	
Submitter email	hemantmehra121@bbdu.ac.in
Similarity	7%
Analysis address	hemantmehra121.bbduni@analysis.urkund.com

Sources included in the report

W	URL: http://repository-tnmgrmu.ac.in/10867/1/240226619abirami.pdf Fetched: 2022-12-19 07:26:30	1
W	URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5072075/ Fetched: 2020-08-03 00:00:59	5
W	URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4705162/ Fetched: 2021-06-16 09:05:52	1
W	URL: https://www.researchgate.net/publication/316860289_Maxillary_ridge_expansion_followed_by_immed... Fetched: 2021-08-11 11:10:17	3
W	URL: http://www.medicalsciencejournal.com/download/1240/5-1-80-351.pdf Fetched: 2022-12-10 17:01:45	1
W	URL: https://www.researchgate.net/publication/259876644_Mandibular_Ridge_Expansion_Using_a_Horizont... Fetched: 2021-06-16 08:33:36	1
SA	**EFFICACY OF SANDWICH OSTEOTOMY WITH SIMULTANEOUS IMPLANT PLACEMENT FOR MANAGEMENT OF VERTICAL DEFECIENCY.docx** Document EFFICACY OF SANDWICH OSTEOTOMY WITH SIMULTANEOUS IMPLANT PLACEMENT FOR MANAGEMENT OF VERTICAL DEFECIENCY.docx (D126746646)	1
SA	**New Microsoft Word Document.pdf** Document New Microsoft Word Document.pdf (D102632623)	1
SA	**whole thesis.docx** Document whole thesis.docx (D45865833)	4
W	URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012101/ Fetched: 2020-07-07 08:50:47	1
SA	**Dr Manish Dev.docx** Document Dr Manish Dev.docx (D91933082)	3

Entire Document

Ethical Clearance Form

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

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

Communication of the Decision of the IXth Institutional Ethics Sub-Committee

IEC Code: 28 **BBDCODS/04/2022**

Title of the Project: Efficacy of ridge split technique in horizontal alveolar ridge augmentation for implant placement.

Principal Investigator: Dr Shahanika **Department:** Oral & Maxillofacial Surgery

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

Type of Submission: New, MDS Project Protocol

Dear Dr Shahanika,

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

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

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.
The comments were communicated to PI thereafter it was revised.

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

Forwarded by:

Lakshmi Bala

(Dr. Lakshmi Bala)
Member-Secretary
IEC

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

(Dr. Puneet Ahuja)
Principal
BBDCODS

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

Institutional Research Committee Approval

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

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Efficacy of Ridge Split Technique in Horizontal Alveolar Ridge Augmentation for Implant Placement."** submitted by **Dr Shahanika** Post graduate student from the **Department of Oral & Maxillofacial Surgery** as part of MDS Curriculum for the academic year 2020-2023 with the accompanying proforma was reviewed by the Institutional Research Committee present on **12th October 2021** at BBDCODS.

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

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

CONSENT FORM

Patient's Name:_____ Date……

1. I hereby authorize Dr_____ To treat the condition described as:_____

2. The procedure offered to treat the condition has been explained to me in my local/ mother tongue language by oral and schematic explanation and I understand the nature of the procedure to be:_____

3. I understand that certain investigative procedures are to be carried out before and after the surgical procedure to perform the surgery and to assess the outcome of the surgery.

4. I understand that incisions will be made inside my mouth for the purpose of placing one or more endosteal root form structure (Implant) in my jaw to serve as anchors for a missing tooth or acknowledge that the doctor has explained the procedure including the number and location of the incisions and the types of implant to be placed. I understand that the crown bridge or denture will later be attached to this implant.

5. I understand that No guarantee can be or has been given that the implants will last for specific time period. It has been explained that once the implant is inserted, the entire treatment plan must be followed and completed on schedule. If the planned schedule is not carried out the implant may fail.

6. I have been informed about the possible alternative methods of treatment (If any). I understand that other forms of treatment if at all, are choices that I have and risks of those choices have been presented to me.

7. Doctor has explained me that there is certain inherent and potential risk and side effect of any surgical procedure and in this instance, such risk includes, but is not limited to-

a. Postoperative discomfort and swelling that may require several days of at home recuperation.

b. Prolonged or heavy bleeding that may require additional treatment.

c. Postoperative infection that may require additional treatment.

d. Stretching of the corners of the mouth that may cause cracking or bruising that may heal slowly.

e. Restricted mouth opening for several days. Sometimes related to swelling and muscle soreness and sometimes related to stress of the joints.

f. Injury to nerve branches in the lower jaw resulting in pain, numbness or tingling of the chin, lips, cheek, gums or tongue on the operated sites. These symptoms may persist for several weeks, months or in rare instance may be permanent

g. Fracture of the jaw or perforation of thin bony plates.

h. Use of the other material which may have to be removed at a later date

i. Implant or prosthesis fracture or loss of the implant due to rejection of the body.

j. Others

8. It has been explained to me that during the course of the surgery unforeseen conditions may be revealed which will necessitate extension of the original procedure or a different procedure from that set forth in paragraph 2 above. I authorize the doctor to perform such additional procedure as and when necessary and desirable in the exercise of professional judgment.

9. I consent to the administration of anaesthesia I have chosen, which is

Local anaesthesia ( ) General anaesthesia ( )

10. Anesthetic Risks:

Local Anaesthesia: toxicity, idiosyncrasy, allergy, anaphylactoid reaction, infection, local tissue reaction, syncope, muscle trismus, pain, oedema, broken needle, prolong anaesthesia, hematoma, sloughing, bizarre neurological symptoms.

General Anaesthesia:

During G.A: Respiratory depression, cardiac arrhythmias, aspiration, laryngospasm, delirium, convulsion, fall in B.P

After G.A: Nausea, vomiting, persisting sedation, aspiration, pneumonia, organ toxicity, nerve palsy, cognitive defects.

CONSENT:

BEFORE SIGNING PLEASE ASK THE DOCTOR IF YOU HAVE ANY QUESTION CONCERNING THE INFORMATION ON THIS CONSENT FORM.

Patient's (guardians) sign date:

Place:

Patient's left thumb impression

Witness' signature with left thumb impression date:

Place:

Doctor's signature date:

Place:

CASE HISTORY PROFORMA

Name:

Age/sex:

Address:

Occupation: Tel no:

Chief complaint:

History of present illness:

Past medical history:

Drug allergies:

Current medications:

Previous hospitalizations if any:

PERSONAL HISTORY

Habits:

Oral hygiene status:

Tooth brushing technique:

Frequency of brushing:

GENERAL EXAMINATION:

Extra-oral examination:

TMJ status:

Lip line:

At rest:

During speech:

Soft tissue support:

Intra-oral examination:

Teeth present:

Teeth missing:

Periodontal status:

Existing prosthesis:

Existing occlusion:

Inter-arch space:

Existing vertical dimension of occlusion:

Teeth requiring replacement:

Cause for replacement:

Evaluation of the tooth to be replaced:

1. crown root ratio:

2. periodontal status:

3. alignment:

4. relationship with anatomic structure:

Radiographic evaluation:

Cone beam computed tomography:

Blood tests:

bleeding time:

clotting time:
haemoglobin level:

random blood sugar level:

Blood pressure:

DIAGNOSIS:

TREATMENT PLANNING:

Whether Bone Graft is placed: yes/no

Type:

Is Guided Tissue Regeneration needed: yes/no
If yes which:

Implant selection rationale with diagram:

1. Type:

2. Numbers:

3. Length:

4. Diameter:

5. Biomaterials of implants used:

6. Date of loading of implant:

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

Guidelines for Devising a Participant / Legally Acceptable Representative Information Document (PID) in English

Guideline for preparation of the participant information document

1. **Study Title**
   Efficacy of ridge split technique in horizontal alveolar ridge augmentation for implant placement.

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

3. **What is the purpose of the study?**
   The purpose of this study is to access the efficacy of the of ridge split technique in horizontal alveolar ridge augmentation for implant placement in horizontally deficient alveolar ridges.

4. **Why have I been chosen?**
   You have been chosen for this study because you fulfilling the required the criteria for this study.

5. **Do I have to take part?**
   Your participation in the research is entirely voluntary. However, as the study doesn't warrant any additional procedure or a new procedure to be performed on you apart from ridge split technique with implant surgery required for the study. Taking part in the research is entirely voluntary. It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still are free to withdraw at any time and without giving a reason.

6. **What will happen to me if I take part?**
   Your participation in the research is entirely voluntary. If you do, you will be given this information sheet to keep and will be asked to sign a consent form. During the study are still free to withdraw at any time and without giving a reason.

7. **What do I have to do?**
   You have to avoid eating hard food from surgical site till prosthetic rehabilitation is given.

8. **What is the procedure that is being tested?**
   It is a ridge split technique which is perform in a knife edge alveolar ridge for dental implant placement.

9. **What are the interventions for the study?**
   It is the type of surgical intervention.

10. **What are the side effects of taking part?**
    Post operative pain or dull ache possible are normal side effects. If you suffer these or any other symptoms you should report immediately. You are also given contact name and number to phone if you become in any way concerned or in case of emergency.

11. **What are the possible disadvantages and risks of taking part?**
    No or minimal side effect of drugs. Pregnant patients and patient below 18 years are not allowed to take part in study.

12. **What are the possible benefits of taking part?**
    There is no intended clinical benefit to the patient/volunteer from taking part in the study.

13. **What if new information becomes available?**
    If additional information becomes available during the course of the research it will not affect your participation as your participation ends as soon as the implant placement is done. If you decide to withdraw, your researcher will make arrangements for your withdrawal. If you decide to continue in the study, you may be asked to sign an updated consent form.

14. **What happens when the research study stops?**
    If the study stops/finishes before the stipulated time, this will be explained to you.

15. **What if something goes wrong?**
    If any severe adverse event occurs, or something goes wrong during the study, the complaints will be handled by reporting to the institution (s), and IEC.

16. **Will my taking part in this study be kept confidential?**
    Yes, it will be kept confidential.

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

The result of the study will be published in the indexed journal. Your identity will be kept confidential in case of any report/publications.

18. Who is organizing the research?

This research study is organized by the candidate and Department of Oral & Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, BBD University, Lucknow.

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

Yes, only the data obtained will be published.

20. Who has reviewed the study?

The study has been reviewed and approved by the Head of the Department and the IEC of
the institution.

21. Contact for further information

Dr Shahanika

DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY,

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES.
E-mail ID- drshahanika@gmail.com
Telephone: +91 8874519531

Dr. Lakshmi Bala,

Member Secretary of Ethics Committee of the institution

bbdcods.iec@gmail.com

Thank you for taking out your precious time to reading the documents and participating in the study.

Signature of PI……
Name……..
Date……..