https://doi.org/10.48047/AFJBS.6.5.2024.10518-10533

AfricanJournalofBiological Sciences

Alveolar Ridge Split – A Boon for Atrophic Alveolar Ridges

Dr. Aditi Chaturvedi[1], Dr Amit Bhardwaj[2], Dr Megha Tomar[3]

1. Project Research Scientist-I (Medical), CDER, All India Institute of Medical Sciences, New Delhi.
2. Professor & HOD, Department of Periodontology, Faculty of Dental Sciences, SGT University, Gurgaon, Haryana
3. Senior Resident, Sanjay Gandhi Memorial Hospital, New Delhi

*Corresponding Author
Dr Aditi Chaturvedi, MDS
Phone Number-8130605556
Email Id-chaturvediaditi50@gmail.com

There are no conflicts of interest declared by any of the author.

Article History
Volume 6, Issue 5, 2024
Received: 22 May 2024
Accepted: 03 Jun 2024
doi:*10.48047/AFJBS.6.5.2024.10518-10533*

Abstract

The treatment of edentulous spans in the oral cavity has been transformed by dental implants. because of growing renown and favourable word of mouth. The patients have a preference for this specific therapy modality over alternative possibilities. Since no two patients are alike, this specific method has given rise to several issues. An example of this would be the atrophic edentulous span. The implant cannot be positioned in the designated location due to an atrophic edentulous span, and there are issues with sufficient osteointegration. The main complaint of the 32-year-old male patient in the case report below was missing teeth when he first arrived at the Department of Periodontology. Upon assessment, it was determined that there was not enough room in the edentulous span to place implants. Piezo surgery in conjunction with a ridge split technique was the chosen treatment modality.

Introduction

After tooth loss, individuals in need of dental implant therapy frequently experience the resorption of the alveolar ridge. There are numerous ways to generate at least 1 mm of bony wall around screw-type implants by augmenting the alveolar crest either before to or following implant implantation. [1]

Numerous surgical widening methods, such as horizontal distraction osteogenesis and lateral augmentation with or without guided bone regeneration (GBR), have been reported. Another approach is to expand the residual ridge that already exists; this is also known as split crest, ridge splitting, bone spreading, or the osteotome procedure. This method widens the edentulous ridge by creating a sagittal osteotomy between the two cortical plates with tools like chisels, which makes it possible to put implants. Dr. Hilt Tatum pioneered ridge splitting for root-form implant insertion in the 1970s. To enlarge the resorbed residual ridge, Tatum created specialized tools such as D-shaped osteotomes and tapered channel formers.[2]

In order to put implants or insert an interpositional bone graft, the edentulous ridge is expanded using the ridge splitting procedure. This method works best for increasing ridge width. For implant placement, there needs to be enough accessible bone height and no vertical bone defects. When inserting a bone chisel between cortical plates, a minimum of 3 mm of breadth is required, which includes at least 1 mm of cancellous bone. This will cause the cortical bones to expand. The best candidate for this procedure is a pyramidal form ridge with a larger base, since this will reduce the chance of buccal plate fracture. The mandible's decreased flexibility as a result of osteotomization increases the risk of fracture of the osteotomized segment.[3]

The foundation of the piezoelectric system is the observation that some crystalline formations, like quartz, will undergo a shape-changing process when exposed to an alternating voltage at an ultrasonic frequency. This vibration causes tip movement, which is mainly linear in direction.This method has the benefit of cutting hard tissue precisely and easily without causing any harm to soft tissue.[4]

Vercellotti et al. revived this strategy for nerve and soft tissue preservation surgery in 2000, overcoming the drawbacks of using conventional equipment for oral bone surgery. Alveolar crest expansion, sinus grafting, and pre-prosthetic surgery were the initial uses documented.[5]

Classification of Deficient Alveolar Ridges

For the preprosthetic surgery, Cawood and Howell proposed an anatomic classification of the edentulous jaws in 1988. It described the alterations (the pattern of resorption) that the edentulous alveolar process in the front and posterior maxilla and mandible experiences following tooth extraction in six different classes. Jensen (1989) presented a classification scheme for implant-driven sites based on the quantity, quality, and proximity of bone to important structures. Wang and Al-Shammari (2002) proposed the edentulous ridge expansion approach (ridge-split) for the horizontal and combination defects of the alveolar ridge. They also described a practical (therapeutically oriented) classification of alveolar ridge defects, namely horizontal, vertical, and combination defects.[6]

Alveolar ridge width (mm), based on CBCT* scan	>10	8–10	6–8	4–6
Alveolar ridge deficiency	No deficiency	Minimal	Mild	Moderate
Class	0	I	II	III
Schematic diagram				
Comments				
Indications for surgery	Hard tissue surgery is not indicated. Occasionally, alveolar width (buccal convexity) can be improved for esthetic reasons with a soft tissue graft.	Hard tissue surgery is rarely indicated. Occasionally, alveolar width can be improved by particulate bone graft or palatal soft tissue graft for esthetic and prosthetic reasons.	Particulate (GBR) grafting or ridge-split is often needed to improve labial bone projection and proper occlusal implant position.	An ideal width for the ridge-split procedure that can be done in a single- or two-stage approach (see Figure 3). Block graft or GBR can also be done.
Immediate insertion	Yes	Yes	Yes/no, depends on presence of apical bone for primary implant stability	Yes/no, depends on presence of apical bone for primary implant stability (see Figure 4)
Operator experience	Basic	Basic	Basic	Basic to advanced

2–4	<2	6–10/2–4	2–4/6–10
Severe	Extreme	"Hourglass" (undercut) (buccal or lingual)	"Bottleneck"
IV	V	VI	VII
			
		GBR† at the mid ridge level can be done	Ridge reshaping or GBR at the top of the ridge can be done
Ridge-split or block bone graft is a graft of choice (surgeon's experience).	Large extraoral block graft is a preferable surgical choice. Alternative is multiple and sequential augmentation procedures.		
Not recommended	No	Yes/no, depends on the severity of the undercut	Usually yes, can depend on the morphology of the top portion of the ridge
Advanced	Advanced	Basic	Basic

Cawood and Howell (1988)

	Comparison	Monocortical Block Grafting (Intraoral)	Ridge-split Procedure
1	Type of grafting	Onlay: external, "cortex to cortex"; donor cortical graft is added to the collapsed recipient buccal cortical bone, resulting in the grafted bone that has cortical environment on one side and periosteum on the other side	Inlay: internal (like an "open book"); cortical envelope is preserved and expanded and a particulate grafting is done "from within," resulting in a bilateral proximity of the grafted bone to both cortices (similar to a 4-wall defect of extraction socket)
2	Graft resorption	Free (devascularized) graft; the grafted bone may contain a substantial amount of nonvital bone that did not survive detachment, devascularization, and transportation; an increased risk of postoperative graft resorption[27]; slow and incomplete neovascularization rate[28]	Vascular bone flap (muco-osteo-periosteal flap) (see Figure 3), vascularization is preserved at all times; "cancellous bone grafts are more rapidly and completely revascularize than cortical grafts"[29] Decreased risk of postoperative graft resorption[16]
3	Donor site morbidity	Yes: pain, swelling, IAN* injury (posterior mandible, ramus), "wooden teeth sensation" (chin), sinus perforation (zygomatic buttress), others	No
4	Recipient site morbidity	Soft tissue dehiscence and graft exposure, loose fixation screws and graft mobility; graft loss	Soft tissue dehiscence and graft exposure, buccal plate malfracture; inadequate split
5	Wound closure	Primary wound closure is mandatory	Closure by secondary intention is preferred
6	Buccal soft tissue flap	Buccal flap is lifted and often stretched; tension-free primary closure is important, but can be challenging	Buccal flap is not compromised; it is not lifted and left attached to the buccal periosteum
7	Wound healing	By plasmatic imbibition from the host (recipient) tissue	Internal "coagulum" is easily converted in the woven bone due to protection and excellent vascularization from both cortices throughout the whole process
8	Immediate implant insertion	Traditionally not done	Can be done in some cases (see Figure 4)
9	Delayed implant insertion	Implants are placed into the cortical bone interface 4 to 6 months later	Implants are placed into the cancellous bone interface 4 to 6 months later
10	Environmental factors and long-term stability of a graft	More subject to a postoperative injury ("external" grafting); less long-term stability and more long-term resorption[28]	Less subject to a postoperative injury during mastication; it is more protected ("internal" or interpositional grafting); less long-term resorption and more long-term stability[30,31]

Ten-point comparison of ridge-split and monocortical block bone graft techniques.

Wang and Al-Shammari(2002)

Class	Alveolar ridge width in mm based on CBCT scan	Alveolar ridge deficiency	Indications for Surgery	Immediate Implant Insertion
0	>10	No deficiency	Hard tissue surgery is not indicated. Occasionally, alveolar width (buccal convexity) can be improved for esthetic reasons with a soft tissue graft	Yes
I	8-10	Minimal	Hard tissue surgery is rarely indicated. Occasionally, alveolar width can be improved by particulate bone graft or palatal soft tissue graft for esthetic and prosthetic reasons	Yes
II	6-8	Mild	Particulate (GBR) grafting or ridge - split is often needed to improve labial bone projection and proper occlusal implant position	Yes/no, depends on presence of apical bone for primary implant stability
III	4-6	Moderate	An ideal width for the ridge-split procedure that can be done in a single- or two-stage approach [Figure 3]. Block graft or GBR can also be done	Yes/no, depends on presence of apical bone for primary implant stability
IV	2-4	Severe	Ridge-split or block bone graft is a graft of choice (surgeon's experience)	Not recommended
V	<2	Extreme	Large extraoral block graft is a preferable surgical choice. Alternative is multiple and sequential augmentation procedures	No
VI	6-10/2-4	"Hourglass" (undercut) (buccal or lingual)	GBR at the mid ridge level can be done	Yes/no, depends on the severity of the undercut
VII	2-4/6-10	"Bottleneck"	Ridge reshaping or GBR at the top of the ridge can be done	Usually yes, can depend on the morphology of the top portion of the ridge

CBCT=Cone beam computed tomography, GBR=Guided bone regeneration

Tolstunov's classification of alveolar ridge width

Objective of the Case Report

This article describes a case of simultaneous implant implantation and horizontal ridge augmentation in the left mandibular molar area using the alveolar ridge split technique (ARST).

Case Report

A 45-year-old man with a primary complaint of missing teeth in the lower left back tooth region for the past two years came to the Department of Periodontology, Faculty of Dental Sciences.Complete supragingival and subgingival scaling was done during the first consultation, and the patient received instructions on oral hygiene.The patient's alginate impression was obtained. The patient had CBCT obtained (Figs. 1, 2, and 3). Additional blood tests, including those for hemoglobin, clotting time, and random blood sugar, were carried out.The results of the blood tests were well within acceptable bounds.

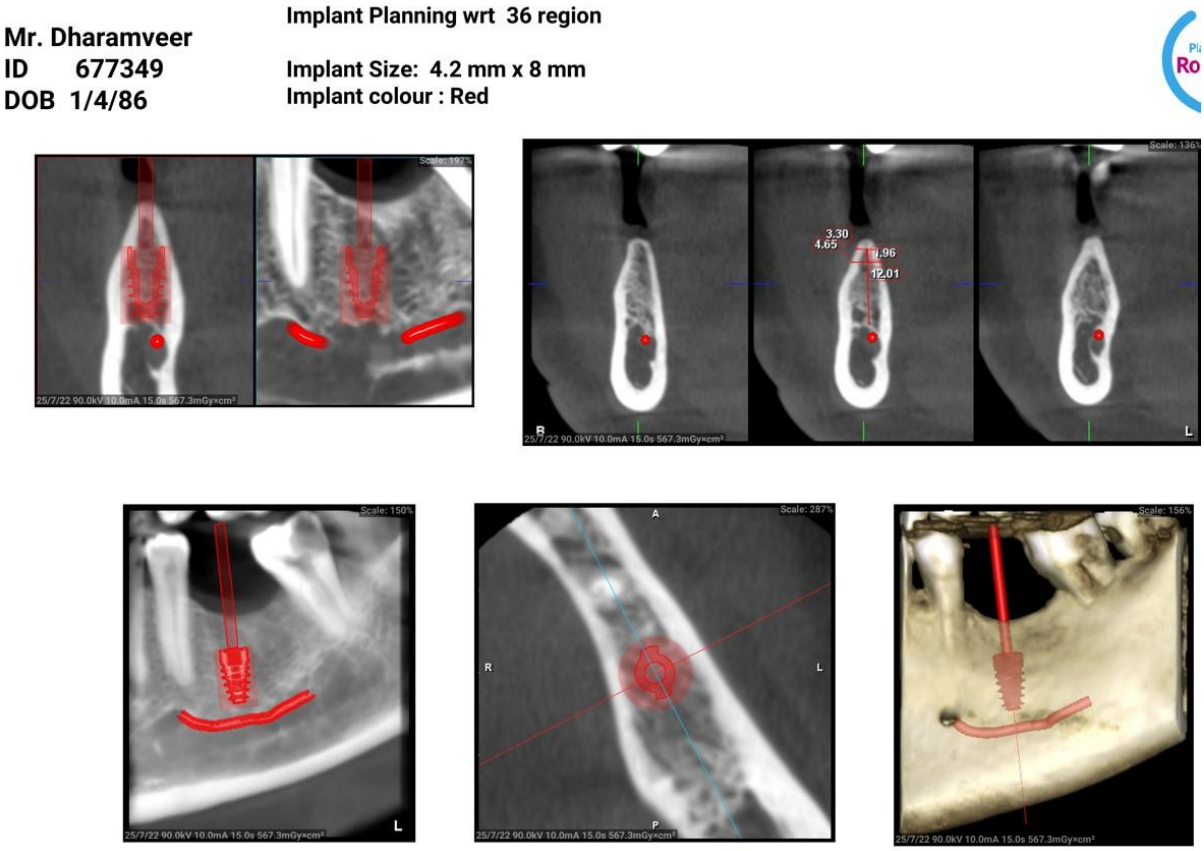

Fig-1-Pre-Operative CBCT

Procedure

At the first molar location, the radiographic examination shows a 4mm buccolingual bone thickness. Anesthesia was applied to the left mandibular area using a 2% lidocaine to epinephrine ratio of 1:100,000. The ridge crest, which was roughly 4 mm buccolingually, was exposed by making a clean incision in the midcrest with a 15c blade and then lifting a full thickness flap. To split the cortical plates apart, an osteotomy was performed on the ridge crest. The scalpel blade was advanced through the bone using a mallet. To avoid breaking the instrument, the scalpel blade was carefully removed by moving back and forth parallel to the cut after it had been tapped to the desired depth.A mallet and chisels with progressively wider blades were utilized to enlarge the osteotomy even more.

The osteotomy site was enlarged using a densa burr. Then, until the intended implant diameter was reached, D-expanders and round osteotomes were tapped into implant sites alternately in increasing order of size. The implants (Adin -4.2mm × 10mm) were placed gradually because they require less bone growth at the osteotomy's base and provide more progressive bone expansion as the implant advances. After placing the cover screws, 3-0 silk sutures were used to approximate the tissue. The patient was given postoperative instructions, which included a prescription for antibiotics and analgesics along with a seven-day supply of 0.2% chlorhexidine mouthwash. After fifteen days, the sutures were taken out.

Fig 2-Pre-operative site 36

Fig3-Pre operative

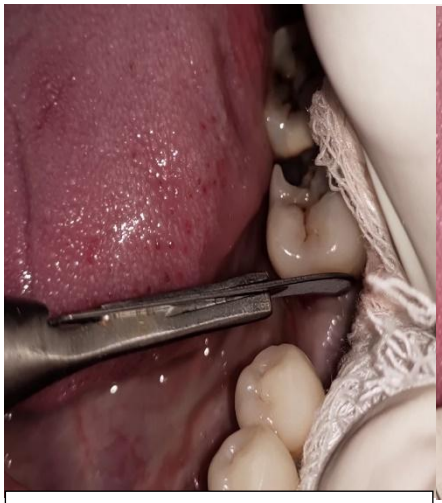

Fig 4-Placement of Crevicular Incision

Fig 5-Placement of Para-Crestal Incision

Fig 6-Elevation of the Surgical Site

Fig 7-Flattening of the Crestal surface using a Handpiece and Chisel Burr.

Fig 8-Photograph taken after Flattening of the Crestal Surface

Fig 9-Use of Piezoelectric Unit to mark the mesial and distal

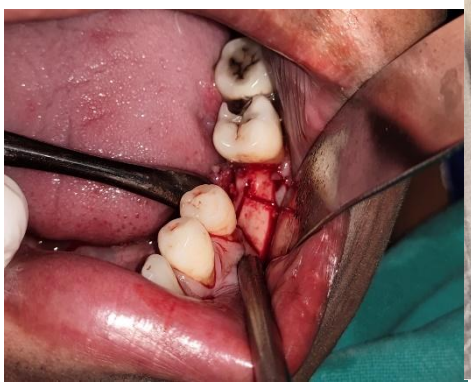

Fig 10-After marking Osteotomies

Fig 11-Radiograph taken post creation of osteotomy site

Fig 12-Separation of buccal cortical bone using chisel and mallet

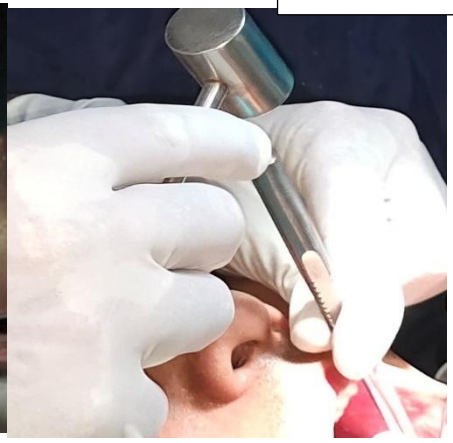

Fig 13-Widening of Buccal and Lingual Shelf area

Fig 14-Widening of the Buccal and Lingual Shelf Area

Fig 15-Pilot drill

Fig 16-Use of Densa Burr to create the Osteotomy site

Fig 17-Placement of implant at the surgical site.

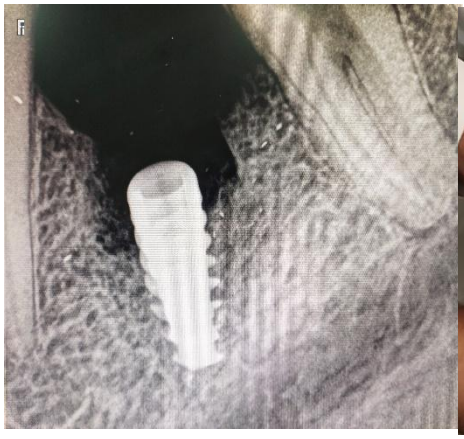

Fig 18 -Radiograph taken after fracture of the buccal cortical plate

Fig 19-Blood sample taken from the patient to make PrF

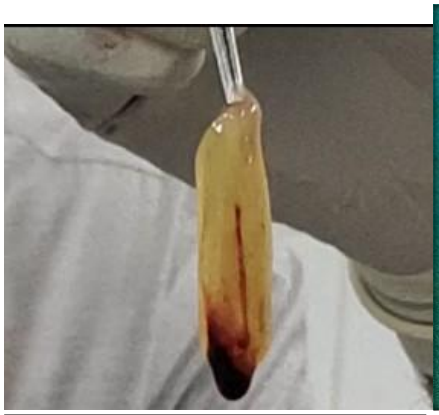

Fig 20-Prf Membrane

Fig 21-Novabone graft (Perioglas)

Fig 22-Fractured Buccal cortical plate used as an autogenous bone graft.

Fig 23-Condensation of the bone graft and barrier membrane at the surgical site

Fig 24-Immediate Post Operative picture taken after Suturing

Fig 25-Immediate Post Operative Radiograph taken

Fig 26-Post Operative photograph taken after 15 days

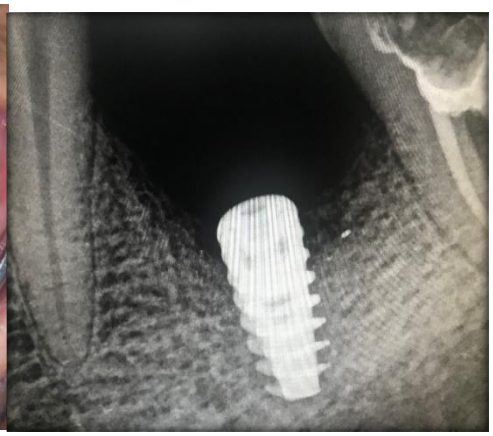

Fig 27-Post Operative Radiograph taken after 15 days.

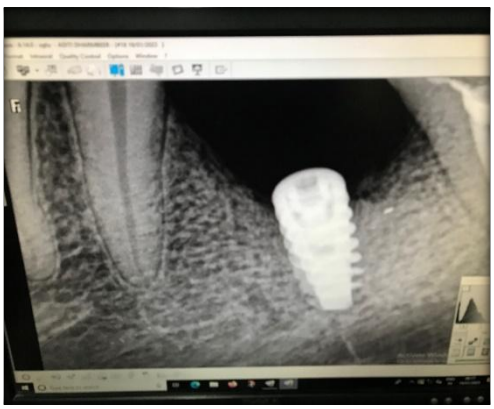

Fig 28-Post Operative Radiograph taken after 6 months .

Discussion

Dr. Hilt Tatum promoted ridge splitting for root-form implant insertion in 1970. To enlarge the resorbed residual ridge, Tatum created specialized tools such as D-shaped osteotomes and tapered channel formers. Based on clinical experience, the narrow residual ridge can be effectively managed with the ridge splitting procedure. For new bone to grow around dental implants, the surrounding periosteum must be kept in place and the bone must be carefully prepared.[6]

In these situations, the process of forming new bone is comparable to the healing of a bone fracture. Between the two bone plates, a blood clot forms, which subsequently organizes and is replaced by woven bone. At the implant interface, this braided bone is subsequently transformed into load-bearing lamellar bone. Due to the fact that an undamaged periosteum on the bone's lateral surface maintains an adequate blood supply, minimal mucoperiosteal flap is reflected during the surgical operation in order to expose the crest of the bone. A scalpel and mallet are used to properly make the mid-crestal incision.

The ridge is expanded using thin chisels and tapered osteotomes following the crestal incision. A fissure bur can be used to make the crestal incision if the bone is dense. A vertical cut may be made at both ends of the incision in the facial cortical plate if the bone expansion is problematic. The bone graft is positioned around the implants and in the space created by the split cortices. When compared to onlay grafting methods, the prognosis of an interpositional bone graft is frequently better.[8,9] Although certain studies do not support implantation, interpositional grafts generally have a better prognosis because they have an expanded vascular bed in an osteogenic environment and are shielded from masticatory action.[5]. It has also been suggested that platelet-rich fibrin can improve wound healing.

This method is indicated by a ridge that is lacking in width but has an appropriate height and no vertical flaws. The maxilla's bone is cancellous and can be expanded without difficulty, it is preferred over the mandible. Benefits include the possibility to insert implants without the need for a second surgery, a shorter total length of therapy, cost effectiveness, and enhanced implant stability due to the development of new bone between cortical plates. Some

drawbacks include the fact that primary closure is challenging to attain, primary stability of the implant is relatively low, and ridge defect is more severe in the event that the treatment fails due to poor case selection.

Conclusion

When managing thinner ridges, ridge splitting procedures offer the benefits of simultaneous implant placement and ridge growth. While this surgical method can be used to either jaw, it is most appropriate for the maxilla. A successful surgical and prosthetic outcome depends on careful patient evaluation and case selection.

References

1. Sethi A, Kaus T. Maxillary ridge expansion with simultaneous implant placement: 5-year results of an ongoing clinical study. Int J Oral Maxillofac Implants 2000;15:491-9.
2. Scipioni A, Bruschi GB, Calesini G. The edentulous ridge expansion technique: A five-year study. Int J Periodontics Restorative Dent 1994;14:451-9.
3. Lieberman JR, Friedlander GE. Bone Regeneration and Repair. 1st ed. Totowa, NJ: © Humana Press; 2005. p. 195-6.
4. Summers RB. The osteotome technique: Part 4 – Future site development. Compend Contin Educ Dent 1995;16:1090, 1092.
5. Misch CE. Density of bone: Effect on treatment plans, surgical approach, healing, and progressive boen loading. Int J Oral Implantol1990;6:23-31.
6. Tatum H Jr. Maxillary and sinus implant reconstructions. Dent Clin North Am 1986;30:207-29.
7. Scipioni A, Bruschi GB, Giargia M, Berglundh T, Lindhe J. Healing at implants with and without primary bone contact. An experimental study in dogs. Clin Oral Implants Res 1997;8:39-47.
8. Summers RB. A new concept in maxillary implant surgery: The osteotome technique. Compend Contin Educ Dent 1994;15:152-60.
9. Misch CE. Contemporary Implant Dentistry. 2nd ed. St. Louis: The CV Mosby Company; 1999. p. 3-11.

10. Belser UC, Buser D, Hess D, Schmid B, Bernard JP, Lang NP. Aesthetic implant restorations in partially edentulous patients – A critical appraisal. Periodontol 2000 1998;17:132-50.
11. Mechery R, Thiruvalluvan N, Sreehari AK. Ridge split and implant placement in deficient alveolar ridge: Case report and an update. Contemp Clin Dent 2015;6:94-7.