International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 24-10-2018; Accepted: 28-11-2018
www.medicalsciencejournal.com
Volume 4; Issue 12; December 2018; Page No. 158-163

A modified approach for split crest technique and bone expansion to augment narrow alveolar ridges for placement of endosseous implants

Dr. K Upasana[1], Dr. Mukesh Kumar[2*], Dr. Shivendra Chaudhry[3]
[1] Senior Resident, Department of Dentistry, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India
[2] Assistant Professor & H.O.D, Department of Dentistry, Vardhman Institute of Medical SCIENCES, Pawapuri, Nalanda, Bihar, India
[3] Associate Professor, Department of Dentistry, Patna Medical College & Hospital Patna, Bihar, India
[*] Correspondence Author: Dr. Mukesh Kumar

Abstract
Summary: Insufficient width of the alveolar ridge often prevents ideal implant placement. Guided bone regeneration, bone grafting, alveolar ridge splitting and combinations of these techniques are used for the lateral augmentation of the alveolar ridge. Ridge splitting is a minimally invasive technique indicated for alveolar ridges with adequate height, which enables immediate implant placement and eliminates morbidity and overall treatment time. The classical approach of the technique involves splitting the alveolar ridge into 2 parts with use of osteotomes and chisels. Modifications of this technique include the use of rotating instrument, screw spreaders, horizontal spreaders and ultrasonic device.
Aims & Objectives: This study was carried out to determine (a) to measure the alveolar ridge height before and after implant placement and check the bone loss or gain after implant placement, (b) to favorably position the implant into the bone simulating the natural tooth position that is required for optimal restoration, (c) to prevent formation of unfavorable bucco-lingual /bucco-palatal and mesio-distal discrepancy between implant and prosthesis and thus improve esthetics. Patients' response to rehabilitation was monitored clinically & radiographically.
Materials & Method: Among 10 patients, with the average age of 35 yrs were treated for single tooth replacement in esthetic zone by placement of implants. In this study explained a technique of modified ridge split bone expansion osteotomy with simultaneous implant placement in esthetic zone. The alternate use of osteotomes and chisels relieve the stresses at the crest by extending a chisel cuts slight mesial and distal to osteotomy. Unlike segmental ridge splitting, no attempts are made to give vertical osteotomies cuts. The osseous defect was filled up with an equine based bone graft substitute Collagen granules Bio-Gen (Bioteck®, Italy) and covered with a restorable pericardial derived equine based Biocollagen GTR membrane (Bioteck® Italy) after the implant of suitable dimension is placed. The entire Patients' were followed response to rehabilitation clinically & radiographically for one year after loading of implant.
Results: Follow up was done after surgery and placement of implant for marginal bone loss and Osseo integration after one year of implant placement with CBCT scan.

Keywords: alveolar ridge augmentation, dental implants; ridge expansion, ridge splitting; narrow alveolar ridge, osteotomy

1. Introduction
Dental rehabilitation of partially or totally edentulous patients with implants has become common practice in recent decades, with predictable long-term results [1]. There are many benefits of fixed dental implant-supported prosthetics versus traditional crown and bridge or removable tooth-borne prosthetics. 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 relations. The presence of 3-dimensionally ideal bone volume is important for osseous support of a dental implant and to contain graft material if a bone graft is needed. Osseo integration of dental implants is highly predictable when implants are ideally placed in bone. Reduction in the width of the edentulous ridge makes the final prosthetic results less predictable from functional and aesthetic viewpoints because of the palatal or lingual position of the implants and consequent abnormal occlusal loading of these implants. To avoid this, various techniques have been described for alveolar ridge augmentation. To treat narrow alveolar ridges, Bone Splitting or Ridge Splitting has come to be acceptable as a predictable modality. It is based on the premise of relocating the buccal / labial alveolar plate by carrying a bony cut (or multiple cuts) down to the cancellous component. This creates room for implant placement with sufficient surrounding bone. When the bucco-lingual bone width is 3 mm or greater but less than 6 mm, to allow implant placement, augmentation of the alveolar ridge using a ridge expansion technique is a viable option. The 3 mm of bone should have at least 1 mm of trabecular bone sandwiched between the cortical plates. That will ensure adequate cortical

and cancellous bone on either side of the split ridge and facilitate implant healing predictably [5] The possibility of simultaneous implant placement in split sites with predictable healing outcomes, as well as the option of grafting the split ridge so as to allow delayed implant placement in the split site are clinical decisions that pose a dilemma.

This study was carried out to determine (a) to measure the alveolar ridge height before and after implant placement and check the bone loss or gain after implant placement, (b) to favorably position the implant into the extraction socket simulating the natural tooth position that is required for optimal restoration, (c) to prevent formation of unfavorable bucco-lingual /bucco-palatal and mesio-distal discrepancy between implant and prosthesis and thus improve esthetics. Patients' response to rehabilitation was monitored clinically & radiographically.

Materials and Methods

This study was proposed to include 10 patients, on an average 35 year-old who reported to the outpatient From *Department of Dentistry, Vardhman institute of medical sciences, Pawapuri*., India, with chief complaint of missing upper front teeth from since one year & who requested a fixed prosthesis, preferably an implant-supported one. The medical/social and family history was non-contributory. Patients' **i**nclusion criteria were partial upper front edentulous alveolar ridges; insufficient alveolar ridge width for implant placement, alveolar ridge width was at least 3 mm and indicated for a Ridge Split. Exclusion Criteria were**:** insufficient alveolar ridge height for implant placement without violation of Implant:Crown ratio, immuno-compromised patients, chronic smokers, infections/pathological conditions at the planned surgical site,medically compromised patients, poor oral hygiene Pre-operative and post-operative parameters done with Initial and final alveolar ridge width assessment using CBCT. Investigations done are a) Routine blood investigations (BT, CT, Hb % & RBS) b) Denta Scan / appropriate CT modality c) IOPA radiograph d) OPG. Follow Up was done post operatively after 3 months, 6 months and one year. Ethical clearance been obtained from the institution's ethical committee.

Treatment Procedure

Fig 1: Pre- Operative View

Fig 2: Pre-Opertive Radiographic View

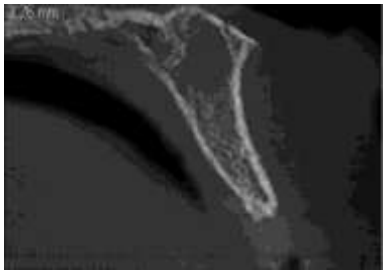


Fig 3: Pre-Cross Sectional Image Showing 4.0 Mm Width At Crest

Fig 4: Pre-Operative Width At The Crest

Fig 5: Use Of Oscillating Saw To Cut The Cortex And Crestal Bone

Fig 6: Use Of Bi-Beveled Osteotome To Initiate Splitting And Expansion Laterally.

Fig 7: Tapered Ostetome Used To Progress Osteotomy

Fig 8: Crest after Ridge Splitting

Fig 9: Implant Placement

Fig 10: Prf and Bone Graft Placed Placement

Fig 11: Suturing Done

Fig 12: Post-Operative Radiographic View

Fig 13: Post-Operative X-Ray after 1 Year

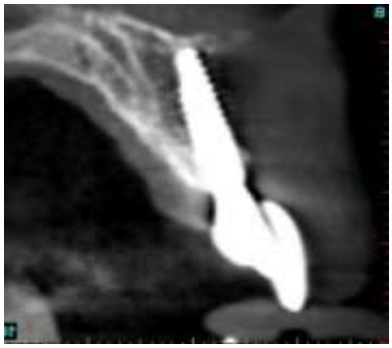


Fig 14: Post-Operative Cross Sectional Image After 1 Year

Pre-Operative Evapuation of Implant Site:

- **Clinical Evaluation of Soft & Hard Tissue and Dentition:** Gingiva was examined for texture, consistency & thickness. Trans-gingival probing was done to evaluate bone topography. Occlusion & inter-occlusal/incisal space was also assessed.
- **Radiographic evaluation:** preoperative computed tomography (CT)**,** IOPA & OPG were taken to assess the quality & quantity of bone at the implant placement site and used as a guide in determining the size of implant to be used.

Surgical procedure

Pre-operative antibiotics and analgesic were prescribed and the patient was prepared in a sterile environment. Local anesthesia lignocaine 2% containing 1:80,000 adrenaline was injected in the area of surgery as an infiltration. A crestal incision was given and combined muco-periosteal and mucosal flap was reflected on labial aspect and only mucoperiosteal flap on palatal side. The combined flap provides advantage of proper flap closure after ridge expansion. The exact location of implant on the ridge was marked by an indentation created by surgical blade. Three types of ridge expanding instruments namely, oscilating saw, uni-beveled chisel, bibeveled osteotome and tapered osteotomes were used in the surgery. All these instruments were used by gentle tapping with mallet. Using Oscillator & uni-beveled chisel (2 mm), with bevel facing labial side, an indentation made on crestal cortex was perforated to reach cancellous bone. The bi-beveled osteotome 2.5 mm, 3.5 mm in length and tapered osteotome 2 mm, 3 mm diameter at the tip were used alternately to expand the osteotomy. [Figure 4-6]

All the instruments after tapping to desired depth were wiggled back and forth in a mesio-distal direction with slight

buccal pressure. This allows expansion of ridge facially with advancing osteotomies as well as easy removal of instrument without any risk of fracturing the labial plate.

Any crestal resistance if felt before reaching desired depth was relieved by advancing chisel cut mesial and distal to osteotomy. It was done using uni-beveled chisel. This chisel cut extension allowed better relieving of stress concentrated at the crest during ridge expansion with osteotome. Similarly, any apical resistance if felt was relieved by the smallest diameter pilot drill by un-touching the crestal bone. The final instruments closely matched the shape of the implant. Self-tapping, threaded, implant 3.5 mm × 11.5 mm implant was carefully placed in expanded osteotomy at same surgical appointment. In all the cases osseous defect was filled up with a equine based bone graft substitute Collagen granules Bio-Gen (Bioteck®, Italy) and covered with a restorable pericardial derived equine based Biocollagen GTR membrane (Bioteck® Italy) after the implant of suitable dimension is placed. The clinical images of the case have been explained in. The expanded ridge with an implant shows healthy amount of peri-implant bone at crest and appropriate flap closure. [Figure 7-12]

This technique if done skillfully and carefully can be helpful to expand and remove labial undercuts, which are major causes of fenestration during implant placement. This will also prevent off-axis loading.

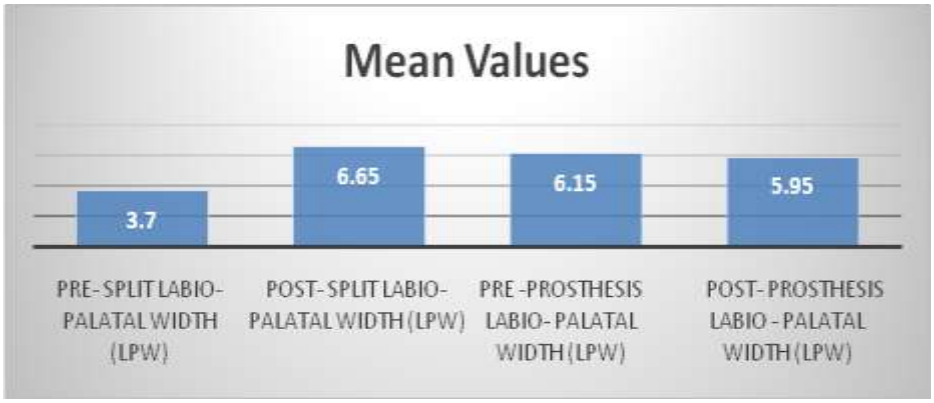
Final Outcome and Follow-Up

The final esthetic outcome with pre-operative and post-operative smile after 1 year shows esthetically satisfactory result. The post-operative CT Scan & Digital OPG X-ray after 1 year shows very minimal bone loss at crest. [Figure 13,14]

Results

Table 1: Distribution of the Patients with Pre and Postoperative Results

S. No.	Age (Yrs)	Sex (M/F)	Implant Placed In Area	Implant Length (Mm)	Implant Diameter (Mm)	Pre- Split Labio-Palatal Width (Lpw)(Mm)	Post- Split Labio- Palatal Width(Lpw)(Mm)	Pre -Prosthesis Labio- Palatal Width (Lpw) (Mm)	Post- Prosthesis Labio - Palatal Width(Lpw)(Mm)
1	30	M	21	11.5	3.5	4	7	6.5	6
2	35	M	11	11	3.5	3.5	6.5	6	6
3	28	M	12	10.5	3	4	7	6.5	6
4	38	F	22	10	3	3.5	6.5	6	5.5
5	39	M	11	11.5	4	4	7	6.5	6.5
6	44	M	21	11.5	3.5	3.5	6.5	6	6
7	48	M	21	12	4	4.5	7.5	7	6.5
8	40	M	21	11.5	3	3.5	6.5	6	6
9	37	M	11	10	3.5	3.5	6	5.5	5.5
10	36	M	22	10	3	3	6	5.5	5.5



Graph 2: Bar Diagram Predicting Increase in Bone Width

Discussion

It is well-established that alveolar ridge <5 mm requires augmentation procedure in order to receive endosseous implant with healthy peri-implant bone of 1.5-2 mm. If implants are placed in areas of inadequate ridge width then following problem can occur [10].

- Dehiscence of labial bone predisposing chances of peri-implantitis, leading to anesthetic metal display through gingiva.
- Leaving a thin bone <1-1.5 mm may predispose to resorption of thinner labial plate in near future, meeting gingival recession and implant exposure and
- Undercuts present on alveolar bone gives rise to off-axis loading.

All these problems can be overcome by augmenting bone either through grafting or by other means. Various treatment options to managed horizontally deficient ridge include increasing width by osteoplasty, using narrow diameter implant, ridge augmentation by autologous block graft, corticocancellous particulate bone graft and allograft using

GBR membrane, distraction osteogenesis and ridge splitting with bone expansion techniques, etc.

Increasing width with osteoplasty results in FP2 and FP3 prosthesis. Narrow diameter implant presents greater mesial and distal cantilever, thus higher tendency of fatigue fracture with abutment and its screw loosening [11]. Ridge augmentation with bone block and GBR technique carries additional donor site, long term waiting period 6-12 months, risk of membrane exposure infection and increase cost to patient without 100% success rate [12, 13]. Distraction osteogenesis leaves patient uncomfortable and is cumbersome [14].

Although ridge splitting and bone expansion appears to be technique sensitive but has many advantages over different technique [5, 6]. It takes advantage of inherent quality of flexibility of cancellous bone. Maxillary bone is pliable and can be slowly manipulated to improve quality (compaction and corticalization) and expanded to desired width. When clinicians allow times for manipulation of bone, it can eventually mold to desired location. It never allows loss of patient bone which is usually unavoidable by mere drilling procedure [15]. The success of this technique also depends on maintaining integrity of labial bone, which occurs as long as periosteum is intact. Periosteum due to its elastic nature allows bone expansion and manipulation and acts as a barrier membrane and makes micro-fracture heals very well because of intact blood supply. Hence it is advisable to leave intact periosteum encasing the bone which can achieved by raising conservative muco-periosteal flap in area of implant placement and then further mucosal flap to coronally advance flap closure.

The ideal indications of ridge splitting and bone expansion procedure are those sites that do not require vertical ridge augmentation and having cancellous bone present between labial and palatal cortical plate. It can be best done in a narrow ridge of minimum 3 mm with greater preference in maxillary bone over mandibular bone.

The technique of ridge expansion osteotomy developed by Summers uses sequence of progressively increasing osteotome to create an osteotomy closely receptacle to implant dimension [5, 6] Though this technique provides atraumatic approach for bucco-lingually deficient ridge but Padmanabhan and Gupta demonstrated greater crestal bone loss associated with osteotome technique compared to conventional technique [8] However they made no attempt to relieve stresses at crest associated with the use of oseotome. The extension of chisel cut mesial and distal to osteotomy prevents stress concentration at the crest and thus crestal bone loss.

Several authors advocated different ridge split technique [3, 4], in which crestal cut osteotomy is joined to adjacent vertical osteotomy cut on either or on both side followed by creation of greenstick fracture of buccal plate. After the expansion of osteotomy to appropriate size, it is either grafted with bone graft (two step) [16] or implant is placed at same appointment (single step) [17]. This technique jeopardizes the blood supply to the fractured buccal plate and hence rate of sequestration is high if not done carefully.

Sethi and Kaus have reported more than 97% of success rate in two staged implant placed by osteotome through maxillary expansion in a 5 year study [18].

References

1. Bidra AS. Surgical and prosthodontic consequences of inadequate treatment planning for fixed implant-supported prosthesis in the edentulous mandible. J Oral Maxillofac Surg. 2010; 68:2528-36. [PubMed]
2. Chiapasco M, Abati S, Romeo E, Vogel G. Clinical outcome of autogenous bone blocks or guided bone regeneration with e-PTFE membranes for the reconstruction of narrow edentulous ridges. Clin Oral Implants Res. 1999; 10:278-88. [PubMed]
3. Scipioni A, Bruschi GB, Calesini G. The edentulous ridge expansion technique: A five-year study. Int J Periodontics Restorative Dent. 1994; 14:451-9. [PubMed]
4. Simion M, Baldoni M, Zaffe D. Jawbone enlargement using immediate implant placement associated with a split-crest technique and guided tissue regeneration. Int J Periodontics Restorative Dent. 1992; 12:462-73. [PubMed]
5. Summers RB. The osteotome technique: Part 2 – The ridge expansion osteotomy (REO) procedure. Compendium. 1994; 15:422. 424, 426, passim; quiz 436. [PubMed]
6. Summers RB. A new concept in maxillary implant surgery: The osteotome technique. Compendium. 1994; 152:154-6. 158 passim; quiz 162. [PubMed]
7. Jaffin RA, Berman CL. The excessive loss of Branemark fixtures in type IV bone: A 5-year analysis. J Periodontol. 1991; 62:2-4. [PubMed]
8. Padmanabhan TV, Gupta RK. Comparison of crestal bone loss and implant stability among the implants placed with conventional procedure and using osteotome technique: A clinical study. J Oral Implantol. 2010; 36:475-83. [PubMed]
9. Palacci P, Nowzari H. Soft tissue enhancement around dental implants. Periodontol 2000, 2008; 47:113-32. [PubMed]
10. Goyal S, Iyer S. Bone manipulation techniques. Int J Clin Implant Dent. 2009; 1:22-31.
11. Quek CE, Tan KB, Nicholls JI. Load fatigue performance of a single-tooth implant abutment system: Effect of diameter. Int J Oral Maxillofac Implants. 2006; 21:929-36. [PubMed]
12. Hämmerle CH, Jung RE, Feloutzis A. A systematic review of the survival of implants in bone sites augmented with barrier membranes (guided bone regeneration) in partially edentulous patients. J Clin Periodontol. 2002; 29(Suppl 3):226-31. [PubMed]
13. Fiorellini JP, Nevins ML. Localized ridge augmentation/preservation. A systematic review. Ann Periodontol. 2003; 8:321-7. [PubMed]
14. Saulacic N, Zix J, Iizuka T. Complication rates and associated factors in alveolar distraction osteogenesis: A comprehensive review. Int J Oral Maxillofac Surg. 2009; 38:210-7. [PubMed]
15. Hahn J. Clinical uses of osteotomes. J Oral Implantol. 1999; 25:23-9. [PubMed]
16. Enislidis G, Wittwer G, Ewers R. Preliminary report on a staged ridge splitting technique for implant placement in the mandible: A technical note. Int J Oral Maxillofac Implants. 2006; 21:445-9. [PubMed]

17. Coatoam GW, Mariotti A. The segmental ridge-split procedure. J Periodontol. 2003;74:757-70.[PubMed]
18. 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. [PubMed]