International Journal Dental and Medical Sciences Research
Volume 3, Issue 3, May - June 2021 pp 174-178 www.ijdmsrjournal.com ISSN: 2582-6018

Alveolar Ridge Splitting Technique for Dental Implant Placement

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Submitted: 15-05-2021 Revised: 26-05-2021 Accepted: 28-05-2021

ABSTRACT: Background and Objective: The availability of adequate bone volume for the placement of dental implant in functionally and aesthetically most appropriate position is sometimes a challenge due to edentulous span of a longer period of time after extraction of teeth, denture wearing for a longer period of time or due to trauma. The present study was conducted with the aim to clinically and radiographically evaluate the efficacy and efficiency of alveolar ridge splitting technique for the placement of dental implant and to evaluate bone widthafter the procedure.**Material and method:** This randomized prospective study consisted of 4 patients who met the inclusion and exclusion criteria. The patients were selected irrespective of the age, sex and socioeconomic status, with the residual alveolar bone width between 2 to 3.5 mm in the edentulous maxillary and mandibular region. Alveolar ridge splitting technique was carried out with simultaneous implant placement. A total of 7 implants were placed. Patients were followed up for 12 months of prosthetic rehabilitation. **Results:** Pre-operative alveolar bone width was on an average 2.9 mm (ranging from 2 to 3.5 mm) with the standard deviation of 0.28 mm. Post-operatively after 3 months on an average 4.42 mm bone width was evident (ranging from 4 to 5 mm) with the standard deviation of 0.77 mm. After 12 months of loading, there wasn't any clinical or radiographical complication. **Conclusion:**Alveolar ridge splitting technique is an excellent procedure for the rehabilitation in the cases with reduced bone width for placement of dental implant.

Key words: Alveolar ridge,ridge split, ridge augmentation, dental implant.

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I. INTRODUCTION

In today's pragmatic world, patients are more interested in the dental treatment with the better esthetic results and less treatment time. Rehabilitation with the dental implant is considered one of the most efficient treatment methods for edentulism. On the horizon of Oral and Maxillofacial Surgery, implant dentistry is one of the most upcoming and progressive field from both clinical and research point of view. Over a period of time, tooth replacement by implant has become successful in view of efficiency and efficacy with functional compliance and longevity.

The availability of adequate bone volume for the placement of dental implant in the functionally and aesthetically most appropriate position is a common problem. Different techniques exist for reconstruction of atrophic alveolar ridges. Those techniquesinvolve chances of surgical risk, post-operative morbidity, and multiple surgeries. Various alveolar ridge widening techniques have been described, including lateral augmentation by guided bone regeneration (GBR), ridge expansion osteotomy, horizontal distraction osteogenesis etc.[1,2,3]

Alternative to all these invasive techniques, a non-invasive technique was originally

International Journal Dental and Medical Sciences Research
Volume 3, Issue 3, May - June 2021 pp 174-178 www.ijdmsrjournal.com ISSN: 2582-6018

first described by Simion et al and later by Scipioni et al. A few literature reports depict different modifications of aridgesplittingtechnique with or without interpositional bone grafting in the edentulous maxilla and mandible. Mainly this technique causes lateral ridge expansion that creates new implant bed by longitudinal osteotomy positioning buccal cortex laterally. The buccal cortex is positioned laterally to create space between buccal and lingual cortical plates, which is filled by endosseous implant with or without any graft material.[2,3,4]

Ridge splitting technique is performed with immediate implant placement, has several advantages that includes:

- Decreases the treatment time significantly,
- Lesser overall cost,
- No need of barrier membranes or bone graft materials,
- Donor site morbidity can be avoided.

Considering the advantages, a study on "Alveolar ridge splitting technique for dental implant placement" was conducted with the aim of:

- To evaluate the efficacy of ridge splitting with simultaneous implant placement,
- To clinically and radiographically evaluate simultaneously placed implant and bonewidth,
- To evaluate the merits and demerits of ridge splitting technique and simultaneousimplant placement.

II. MATERIAL AND METHOD

The study consisted 4 patients (2 male and 2 female) with mean age of 52.7 years (45-65 years), who visited to the department of Oral and maxillofacial surgery of College of dental sciences andresearch centre, with the chief complain of the missing teeth in the upper or the lower jaw. The patients were selected irrespectiveof the age, sex,and socioeconomic status with the residual alveolar bone width between 1 to 4 mm in the edentulous area.

INCLUSION CRITERIA:

- Patients with less than 4 mm width of the residual alveolar ridge in the upper and lower jaw,
- Patients who required implant treatment in maxilla or mandible,
- Patients with maladaptive experience or psychotic resistance to wear a removable partial denture,
- Patients available for regular follow up,
- Well informed and motivated patients who gave their consent willingly for the procedure and for participation in the study.

EXCLUSION CRITERIA:

- Patients with the compromised medical condition like uncompromised systemic disease, uncontrolled metabolic disease, compromised immune system, hematological disorder, pregnancy, prior radiotherapy of the surgical site, chemotherapy, osteoporosis or any other systemic illness,
- Patients with long term oral destructive habits like smoking, gutkha chewing, tobacco chewing, alcoholism, drug addiction, and not willing to quit the habit,
- Patients with the untreated dental diseases or having any pathological lesion in the adjacent teeth or lesion in the same region of the arch,
- Patients with bone bisphosphonate therapy,
- Patients with the unrealistic esthetic expectation.

Figure. 1: Mandibular right canine, right premolar andleft canine. (A): Pre-operative x-ray, (B): Pre-operative clinically, (C): Incision and reflection of flap, (D): Osteotomy site preparation, (E): Ridge splitting using chisel and mallet, (F): Implant drill, (G): implant placement, (H): Closure using interrupted sutures, (I): 3 months post-operativex-ray.

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Detailed history was recordedand thorough clinical examination was done. Oral prophylaxis was performed through scaling in all cases before the surgical procedure was done. Diagnostic impressions were recorded. Radiographic examinations includingintra oral periapical radiograph(IOPA), cone beam computed tomography (CBCT), digital orthopantomogram (OPG) were taken as well as routine hemogram and urine analysis was done. Patient fitness assessed by physician andanesthetist written and informed consent from the patient and patient's relative for anesthesia, surgery was obtained. Antibiotics, analgesics, and mouthwash were started 24 hours pre-operatively. Procedure was performed under local anesthesia by giving respective nerve block with 2% lignocaine HCL with 1:80,000 adrenaline concentration followed by local infiltration.

Crestal incision was given and full thickness mucoperiosteal flap was raised with minimum flap reflection on the buccal and lingual aspects of cortical plates to facilitate good healing (Fig.1:C). Width of the narrow alveolar ridge was measured with the help of the measuring calibre and readings were noted down. For osteotomy site preparation in the patient with alveolar ridge width between 3 to 4 mm-firstly, the alveolar cortical layer is perforated using a rounded drill, no.6 round bur and osteotomy site is marked using 1:20 reduction gear handpiece at the low speed (800 to 1200) rpm with high torque (35 Ncm). Followed by the insertion of osteotome, working up through till the desired length is achieved (Fig.1: D, E).

The expansion osteotomes are inserted manually, pressing and rotating at the same time, until the desired width is reached, or until resistance is encountered. Expansion osteotomes do not eliminate bone during bed preparation; rather, the instrument exerts lateral compression, increasing bone density and thus provide primary implant stability. Operating drills starting from the initial drill size 2 mm to the desired width (eg-3.3, 3.8 etc.) was done with simultaneous placement of the implant and cover screw was placed.

In the cases with the severe alveolar ridge atrophy and having the width <3 mm, because of the presence degree of resistance an initial drilling was not possible, chisel and mallet were used initially to obtain the required initial width for the drilling of pilot drill (Fig.1: F). Before splitting the cortical plates with the help of chisel and mallet, stop cut was marked vertically on the either side of the planned osteotomy site. Chisel and mallet technique involves the splitting of the ridge longitudinally in two parts provoking greenstick fracture, cut and spread apart two cortical plates.In this situation gentle tapping with the surgical mallet was applied, rotary instruments were used (starting with a pilot drill measuring 2 mm diameter). Simultaneously expansion osteotomes from smaller to larger instrument sizes were inserted.

Self-tapping, tapered, threaded, acid etched and sand blasted, titanium implant of the desired measurement was placed in the preparation site (Fig.1:G). Cover screw was placed over the implant with the use of the implant screw driver. Tension free mucoperiosteal tissue closure was done. 3-0 black silkinterrupted sutures (Fig.1: H).

Patients were recalled for the clinical evaluation on 3rd and 7th day and after 1 and 3 months of ridge splitting procedure for the radiographic evaluation by OPG (Fig.1: I).

Second stage procedure was performed after 3 months. Crestal incision over the implant fixature was given and uncovering of implant was performed. A cover screw was removed and healing abutment or gingival former was screwed into the implant. Interrupted sutures were given with 3.0 black silk and removed after 1 week of second stage procedure. The site was allowed to heal for 2 weeks before initiation of the restorative phase.

Prosthetic fabrication was carried out after 2 weeks of second stage procedure. Healing cap was removed and abutment was screwed into the implant and prepared if necessary. IOPA was taken to confirm the proper seating of the abutment. Impressions were recorded with the elastomeric impression material and were sent to the laboratory for the fabrication of the crown. The prepared crown was checked for its passive fit to the abutment. If needed occlusal adjustments were also made prior to cementation. Cementation of the prosthesis was carried out. Necessary follow up was done after upto12 months of prosthetic rehabilitation (total 12 to 18 months respectively)and till the maximal available period after the fixed restoration has been given to the patient.

III. RESULTS

A total of 7 implants were placed in 4 patients. The ratio of male to female patient was 1:1 in this study. The mean age of the patients included in the study was 52.7years (45-65 years) with standard deviation of 7.2 years. Pre-operative alveolar bone width was on an average 2.9 mm (ranging from 2 to 3.5 mm) with the standard deviation of 0.28 mm. On radiographical examinations after 3 months of the ridge splitting procedure, the alveolar bone width was on an average 4.42 mm (ranging from 4 to 5 mm) with

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the standard deviation of 0.77 mm. So, the average bone gain after 3 months of ridge splitting procedure was on an average 1.5 mm (ranging from 1 to 2 mm) with the standard deviation of 0.42 mm.

The implants were loaded after 3 months and 2 weeks of the ridge splitting procedure. After 12 months of loading, there wasn't any clinical complication and no implant mobility, abutment loosening or fracture and prosthesis loosening or fracture in any case. On radiographic examination, two of the cases had shownvertical bone loss of 1mm.

IV. DISCUSSION

Ridge splitting technique which causes lateral ridge expansion creates new implant bed by longitudinal osteotomy positioning buccal cortex laterally. The buccal cortex is positioned laterally to create space between buccal and lingual cortical plates, which is filled by endosseous implant. This technique is performed with immediate implant placement, which decreases the treatment time significantly. Although, this technique is more suitable for maxilla and can be performed in posterior mandibular region if favorable condition exists. Favorable conditions of posterior mandible for ridge splitting techniques include long edentulous span, abundant bone height, and presence of cancellous bone between the dense outer cortical plates.

In one case because of severe atrophy of the ridge which gave the knife ridge appearance creates hinderance for the initial pilot drill. The use of chisel and mallet was done. Chisel and mallet technique involves the splitting of the ridge longitudinally in two parts provoking greenstick fracture, cut and spread apart two cortical plates.In this situation gentle tapping with the surgical mallet was applied, rotary instruments were used (starting with a pilot drill measuring 2 mm in diameter).[5,6] This procedure forms an implant bed and facilitates the placement of implants with wide diameter. In addition, bone regeneration is achieved on both sides, so the bone healing capacity is good, therefore sufficient osseointegration can be achieved with relatively small volumes of bone.

In this study, rough surface implants were used which provide frictional resistance that results in slight bone compression which can improve the initial implant stabilization. Also, rough surface implant achieves greater bone to implant apposition and interfacial strength. Actually, rough surface is better able to stabilize the blood clot on the surface, allowing for bone formation directly on the surface (contact osteogenesis). Implant with rough surface have greater survival rate.[7,8,9]

Minor post-operative complications like pain, mucosal tenderness and facial swelling were observed during the first week after ridge splitting technique procedure. All the clinical complication were resolved completely on its own by 10th day.

Considering all the cases of the study, pre-operative alveolar bone width has on an average 2.9mm (ranging from 1 to 4 mm). On the radiographic evaluation pre-operatively the width was calculated on an average of 3mm (ranging from 2 to 4mm).After the ridge spilt technique the final bone volume gain was on an average 3.5mm (ranging 4 to 6 mm). Vertical bone loss and peri-implantitis was examined every 1,3,6, and 12 months. The implants were loaded after 3 months after the ridge splitting technique, on clinical follow up of all the cases after 3 months of loading, there wasn't any clinical complication and no implant mobility, abutment loosening or fracture and prosthesis loosening or fracture in any case. On an average 0.5 mm pocket depth was measured (ranging from 0 to 2 mm). On the radiographic examination, the vertical bone loss was on an average of 1mm was measured in two cases on the 18 months of evaluation. No implant failure was observed till 18 months of the ridge splitting technique with simultaneous implant placement.

Referring to a study by Simion et al, endosseousimplant placement using a bone expansion technique shown excellent bone response as well as implant survival using osteotome for placement of dental implants in the maxilla as well as mandible. The key to proper expansion is a slow, gradual technique with controlled force application that leads to gradual expansion and minimal site trauma. It not only allows for the conservative and esthetic alternative to treating partial edentulism, but also provide a stable foundation for treating complete edentulism. Its role in current dental implantology is still non-replaceable.

Alveolar ridge splitting procedure has certain advantages:

- The expansion osteotome technique is more conservative in relation to the neighboring structures than conventional drilling,
- Less operative time,
- No second surgery required as in ridge augmentation procedure,
- It affords superior and inferior manual control in determining the implant axis thereby contributing to avoid fenestrations and dehiscence,
- Lesser peri-implant bone warming, and no bone loss is produced during expansion,

- No need of barrier membranes or bone graft materials,
- No morbidity related to second donor site,
- Is cost effective,
- Can be used with most commercially available implants.

V. CONCLUSION

Following conclusions can be made based on this study

- Ridge splining technique is an excellent technique for the rehabilitation in the cases of atrophic ridge of maxilla and mandible,
- Lateral bone expansion provides adequate bone volume for proper angulation of implant drill and implant,
- Significant width can be gained,
- No requirement of 2 surgical procedure for the implant insertion,
- Use of surface altered implant provides excellent osseointegration,
- Risk of complication is very low,
- Higher predictive results with long term success can be achieved.

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