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Ridge Split With Piezotome in Deficient Edentulous Region of Maxilla and Mandible and Immediate Placement of Implant

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Abstract

AIM: The aim of this study was to evaluate the ridge split-crest technique with piezotome for immediate implant placement in edentulous deficient region of maxilla and mandible by assessing the crestal bone loss and implant success rate.

Materials and Methods: Study included 10 patients who received 11 implants (LASAK implants) with Ridge split surgical procedure using piezotome with a follow up period of 6 months. Clinical assessment included the crestal bone loss, ridge width around implant, and implant success rate.

Results: Eleven implants in 10 patients were evaluated between 2016 and January 2018. Success rate of implants at the end of follow-up was 91%. Bone ridge was measured and compared at final examination showing a mean ridge expansion of 7.1 mm.

Conclusions: Ridge Split-crest with piezotome can be considered an effective and safe procedure for deficient edentulous region in maxilla and mandible providing adequate bone width and stability.

Keywords: Bone Ridge Expansion, Dental Implants, Implant Success, Piezoelectric Surgery, Split-Crest, Piezotome.

Introduction

In the last few decades, the rehabilitation of maxillary and mandibular edentulous areas with dental implants has become common practice, with reliable long-term results. However, for achieving ideal results, implants require the presence of residual alveolar ridges of adequate height, width, and quality of bone to stabilize the implants[1]. However, a deficient edentulous region of the maxilla and mandible, either in terms of ridge height or width, makes such rehabilitation difficult and has to be addressed before implant placement.

Ridge augmentation procedures are undertaken to correct the deficient ridge in whichever dimension is required. This is done often by harvesting autogenous grafts and placing them on the ridge, thus resulting in a secondary donor site morbidity. Horizontal bone augmentation in particular, for the correction of deficient ridge width, is harder to achieve than vertical bone augmentation.

The ridge split technique for horizontal bone augmentation was introduced by Simon et al. in 1992[2]. In 1994, Scipioni et al[3]. also reported immediate implant placement after a ridge split of maxillary alveolar bone. Holtzclaw et al[4]. introduced a piezoelectric hinged-assisted ridge split (PHARS) technique in the atrophic posterior mandible.

The use of the piezoelectric system gives a fundamental qualitative advance to the alveolar ridge splitting technique. It allows control and safety in the osteotomy as well as adequate visibility in the intraoperative stage (Olate et al. 2013)[5]. Ultrasonic devices have the ability to cut mineralized hard tissues as teeth or bone in a very safe and precise way, with minor tissue damage. Soft tissues such as nerves, blood vessels, or the Schneiderian membrane are not altered by the cutting tip because of their ability to oscillate at the same speed and amplitude as the cutting tip[6]. Ultrasonic cuts have also been reported to be more precise and to cause less splintering at the margin of the incision. Moreover, surgical accuracy is facilitated by good visibility in the surgical field due to reduced bleeding. The ultrasonic osteotome also allows curved cuts that are impossible with rotatory instruments or oscillating saws[7]. Additionally, the piezoelectric system has low intraoperative noise, which improves the patient's acceptance of the ridge split technique. Postoperative tissue healing is also better with reduced postoperative pain and swelling, contributing to overall patient comfort.

The aim of this study was to evaluate the ridge split-crest technique with piezotome for immediate implant placement in an edentulous deficient region of maxilla and mandible by assessing the crestal bone loss and implant success rate

Materials And Methods

Ten patients of age 20-65 years, with partial or completely edentulous alveolar ridges of insufficient alveolar ridge width (thin/ knife-edge ridges) of no less than 3 mm and indicated for a ridge augmentation by ridge split technique were included in the study. (Fig.1)

Patients with insufficient alveolar ridge height for implant placement without violation of implant crown ratio, immunocompromised patients, chronic smokers, infections/pathological conditions at the planned surgical site, medically compromised patients, and poor oral hygiene were excluded.

Preoperative clinical assessment of the ridge width was done with calipers and radiological assessment of the height and width of the residual bone ridge was done with CBCT.

A.Surgical Procedure:

A standard aseptic surgical protocol was adopted in all the cases to place the implants. Under local Anesthesia, a mid-crestal incision was given over the edentulous area and vertical releasing incisions were given on both sides for reflection of a full thickness mucoperiosteal flap. Mid-crestal osteotomy with a piezotome was performed into the alveolar ridge. This osteotomy was extended as far as the narrow alveolar crest present. Two vertical cuts were then used on the proximal and distal ends of the mid-crestal osteotomy. Vertical osteotomies were deepened 3 mm through the cortical bone with preservation of intact cancellous bone. (Fig.2) A green-stick fracture of the cephalad (maxilla) / caudal (mandible) horizontal corticotomy was carried out with the introduction of a thin chisel. Following this maneuver, progressive thick osteotomes were introduced between buccal and palatal or lingual cortical plates in order to obtain the desired

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widening of the inter-cortical gap. The sequential introduction of the osteotomes from a smaller to bigger width allowed safer and more controlled splitting of the alveolar ridge. Finger pressure was applied to stabilize the facial plate of bone. After establishing the initial ridge split, spiral drills were used to enlarge the implant osteotomy. After preparation of the implant osteotomy site, the implant was transferred on the respective site. Gaps around the implant were filled with hydroxyapatite bone graft and closure done.

The second stage surgery was done after a healing period of 6 months. The implant was exposed without damaging the surrounding bone. Implant stability was recorded with Ostell mentor device (resonance frequency analyzer) (Figrue 3) before placing the gingival former and was kept in place for 2 weeks.

Primary implant stability was assessed with the help of reverse torque test at the time of the placement of the implant. The post-operative assessment was done to clinically measure alveolar ridge width by physical caliper. Crestal bone loss was assessed on intraoral periapical radiographs which were taken at immediate and 6 months after implant placement and implant stability by ostell mentor at immediate and time before placing gingival former.

The IOPA's of all the patients were collected, at the time of implant placement and after 6 months post op. Photographs of all the IOPA's were taken by a still digital camera, The implant length in all the cases was known and the apparent length of the implants was calculated in millimeters directly from the photographs of IOPA by using a metallic scale.The IOPA's that were used were non-standardized and the formula to calculate bone loss from a non-standardized IOPA was given by Roy H. Yoo et al. First, the entire length of the implant was measured on the photograph. Then the apparent level of the crestal bone was measured both on the mesial and the distal sides by drawing a line from the tip of the implant head to the coronal most level of the crestal bone on the photograph. The length of the implant and the level of the crestal bone were marked on the photograph with the help of a marker pen. The length of the implant and the level of crestal bone on both mesial and distal sides are measured in millimeters (mm) with the help of a metallic scale. Then the corrected level of the crestal bone was calculated by the following equation given by Yoo et al[8].

$$\text{Corrected bone level} = \frac{\textbf{Apparent bone level x actual implant length}}{\textbf{Apparent Implant length (on the IOPA radiograph)}}$$

The bone levels were calculated according to the above-mentioned equations on both mesial and distal sides of the implants using the photographs of the radiographs taken just after implant placement, and at 6 months. The same procedure was repeated for all the radiographs and the crestal bone loss on the mesial and the distal sides was recorded.

Clinical results of this study were statistically analyzed in the form of mean, standard deviation (SD) values. T-Test, NPar tests, and Wilcoxon signed ranks test were used for statistical analysis.

Fig.1: Knife edge ridge in patient

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Fig.2: Osteotomy cuts placed with peizotome

Fig.3: Implant stability assessment with Ostell mentor device

Results

Out of 10 patients that were included 70% were female, in whom 3 implants were placed in anterior maxilla, 4 implants in posterior mandible and 1 implant in posterior maxilla) and 30% were males in whom (2 implants were placed in anterior maxilla and 1 implant placed in posterior maxilla).

Out of eleven implants, 2 implants were positive for percussion test and 1 implant shown lower ISQ value which resulted in the failure of the implant which was placed in the posterior maxilla. (Table 1).

Parameter	Evaluated at the time of	No. of implants	Mean	Std. Deviation	p-value
ISQ	0 month	11	60.12	5.66	0.011
ISQ	6 months	11	75.00	5.31	

Table 1: ISQ values on implats

T-Test results were mean value for initial ridge width was 3.5 and the final ridge width was 7.1. The significant difference is .002.

In our study, the mean CRBL immediately at the time of implant placement in 0 months was .09 on the mesial aspect and 0.13 on the distal aspect. Mean CRBL value after 6 months was 0.53 on the mesial aspect and 0.47 on the distal aspect. There has been found a significant bone loss after 6 months of implant placement. (Fig.4) P-value was 0.015 ($p<0.005$).

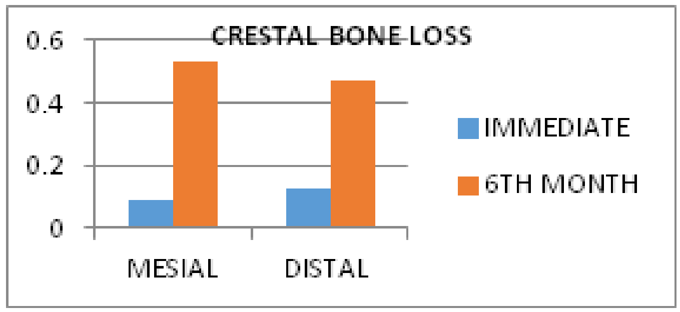

Fig.4: Mean crestal bone loss around the implant

Out of eleven implants, one implant reported with infection and wound dehiscence, which was placed in posterior maxilla (D4 bone) and one implant reported with infection, which was placed in posterior mandible(D3 bone). One implant (D3 bone) was recovered from infection which was placed in posterior mandible after antibiotic therapy.

Discussion

The split-crest procedure in combination with immediate implant placement was described more than two decades ago. This procedure avoids the need for onlay grafts taken from a secondary surgical site, which exhibits post-operative morbidity associated with bone harvesting[9].

Using the split-crest approach, no complications related to the surgical procedure were reported in any case. All implants were placed following general guidelines for implant insertion, using a low-speed drilling procedure and with irrigation, and were placed in different

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anatomical positions and using different types of prostheses. Edentulous alveolar ridges of less than 3 mm in width were considered for bone augmentation procedures after implant placement, to establish a bony wall of at least 1 mm around screw-type implants and thus provide a successful long-term function and esthetics.

A study by Blus and Szmukler- Moncler[9] reported the application of ultrasonic bone surgery to perform split-crest procedures on 57 patients over a period of three and a half years. The aim was to place 230 implants (78 in the mandible and 152 in the maxilla) to rehabilitate nine full arches, three hemiarcades, 43 partial bridges, and 24 single crowns. The initial mean value of the ridge width was 3.2 mm, whereas at the end of the surgery the final mean width was 6 mm. Ninety-nine percent of the implants were placed and eight of them failed to osseointegrate at second stage surgery (96.5% success rate). After loading (at least 2 months for all implants), no implant failed, being the cumulative implant survival rate of 100%.In this study, a mean ridge expansion of 3.5 mm has been obtained after using the split-crest technique. The procedure has permitted a predictable implant treatment of clinical situations that otherwise would not have allowed the insertion of implants. Interestingly, the use of an ultrasonic device for bone cutting has shown clear advantages compared with other alternatives for bone cutting in different surgical procedures. The results of this study support the use of ultrasonic bone surgery in ridge split technique for adequate implant placement in patients with edentulous bone ridges of maxilla and mandible region. Because implants had been loaded after 6 months postoperatively and the status of the implants and the surrounding soft and hard tissues are indicative of the safety and effectiveness of the approach.

There are certain limitations in the present study such as a smaller sample size due to strict inclusion and exclusion criteria, Patient affordability for implants, the costly equipment (Ostell Mentor), Prolonged overall treatment time and short follow up period.

Conclusion

Although this surgical approach may be used in both the jaws, it is better suited for the maxilla because of thinner cortical plates and softer medullary bone which makes it easy to expand (D2 bone). The cortical plates of the residual ridge must be carefully split while maintaining periosteal attachment because maintenance of an attached periosteum is critical to the formation of new bone around the interproximal surfaces of the implants. In contrast to traditional techniques, it allows for immediate placement of implant following surgery and eradicates the other drawbacks such as an increase in the overall treatment period. In the present study, implant success rate was found to be 91%, which is comparable to the reports in existing literature. For successful surgical and prosthetic outcome proper patient evaluation and case selection are essential.

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