OPEN ACCESS Freely available online

Dentistry

ISSN: 2161-1122

Case Report

"Accuracy of Clinical Implant Position with Cad/Cam Assisted Surgical Guide through a Modified Bone Expansion Technique in an Atrophic Premaxilla: A Case Report"

Ramakrishna Harigopal[1*], SK Poovani[1], NS Mamatha[2], G Shetty[1], Srilakshmi J[1]

[1]Department of Prosthodontics, Rajarajeswari dental college and hospital, Bangalore, India;[2]Department of Implantology, Rajarajeswari dental college and hospital, Bangalore, India

ABSTRACT

Aim: To evaluate the accuracy of CAD/CAM surgical guide through a modified bone expansion technique in an atrophic premaxilla.

Background: Achieving the virtual plan of the implant position is a challenging clinical situation especially in an atrophic bone which requires extensive grafting procedures increasing the cost and time of treatment.

Case description: An 18 year old male patient reported with history of partial edentulism in relation to 11, 12 and 21 for past two years. An acrylic stent was fabricated with radiographic markers for virtual planning of implant treatment with pre-operative CBCT. A modified bone expansion technique with a palatal approach which involved the pilot drill preparation slightly 1 mm off the mid crest as compared to the conventional midcrestal approach was carried out in the atrophic pre-maxillary region. A CAD/CAM surgical guide was used for the surgical procedure. Postoperative CBCT with radiographic markers was used for evaluating clinical outcome.

Conclusion: The modified bone expansion technique was able to achieve the planned implant position within the recommended limits of deviation at the same time maintain the integrity of the thin cortical plates.

Clinical significance: A simple modification of the conventional approach of bone expansion can help attain the goal of prosthetic driven treatment plan and also conserve the bone at the osteotomy site.

Keywords: Surgical guide; Dental implant; Bone expansion; Palatal approach; CAD/CAM

Abbreviations: CBCT: Cone Beam Computed Tomography; CAD/CAM: Computer Aided Design/ Computer Aided Milling; VAS: Visual Analog Scale

INTRODUCTION

Replacement of missing teeth with implants has become an indispensable part of the clinical practice over the past few decades [1]. According to reports as early as 1986, the survival rates of single tooth implants range between 90% and 96.3% over a period of 10 years [2]. The success of the implant lies not only on the proper diagnosis, case selection, and treatment planning but also on the meticulous execution which impacts the ultimate functional and aesthetic harmony. Ideal implant position is a key determinant of implant success. Virtual implants planning with the use of technologies like Cone Beam Computed Tomography (CBCT) and Stereo lithographic surgical templates have made implant planning and positioning much more easily. Following loss of tooth it has been observed that the pattern of bone remodeling in the anterior maxilla occurs at the expense of the buccal cortical plate causing a lingual shift of the alveolar ridge [3]. The original protocol proposed by Branemark recommended placing implants upright centered in the crest, completely surrounded by bone. But according to Cawood and Howell classification this can be achieved only in class III maxilla [4]. Also reliable long term effects require sufficient bone thickness of 1 mm or more in the maxillary aesthetic zone to prevent loss of the buccal bone

***Correspondence to:** Harigopal Ramakrishna, BDS, Postgraduate student, Department of Prosthodontics, Rajarajeswari dental college and hospital, Bangalore-560074, India. Tel: +8884747280; Email: ramabds07@gmail.com

Received: April 5, 2021; **Accepted:** April 19, 2021; **Published:** April 29, 2021

Citation: Harigopal R, Shwetha KP, Mamatha NS, Gautam S, Srilakshmi J (2021) Accuracy of Clinical Implant Position with Cad/Cam Assisted Surgical Guide through a Modified Bone Expansion Technique in an Atrophic Premaxilla: A Case Report Dentistry 11:4.

margin and maintain the integrity of the gingival architecture. Several procedures like ridge augmentation and ridge splitting have been enormously substantiated in the literature which would ultimately increase the treatment time, cost and pose risk of post- operative pain, nerve or arterial injury [5].

The bone expansion technique involves horizontal augmentation with minimal trauma and aims to conserve all bone in the surgical site and to selectively displace the bone laterally [6,11]. The main advantage of the crest-expanding technique is that it is a less invasive procedure; the facial wall expands after the medullary bone is compressed against the cortical wall [6,11]. A case report is presented to exhibit the accuracy of the modified bone expansion technique in achieving a clinically acceptable position of implant in an atrophic maxillary aesthetic zone.

CASE DESCRIPTION

An 18 year old male patient reported to the Department of Prosthodontics Rajarajeswari dental college and Hospital, with a chief complaint of unaesthetic appearance due to missing tooth in the upper front teeth region of jaw (Figure 1).

Figure 1: Case scenario: Atrophic maxillary ridge with clinically missing 11, 21 and 22 teeth.

Patient presented with a history of extraction following trauma in relation to 11, 12 and 21 region before 2 years. Following intra oral examination, patient was presented with various treatment options like removable and fixed prosthetic options including implants. The young patient was persistent on undergoing an implant retained fixed prosthetic treatment.

Preoperative planning

An acrylic stent with radiographic markers was fabricated using the diagnostic cast and a preoperative CBCT of maxilla was made with the radiographic assessment stent (Figure 2) for the virtual planning of implant position.

Radiological examination revealed severe buccal bone resorption post extraction in relation to 11, 12 and 21 regions rendering the edentulous site unfavorable to conventional drilling technique.

Figure 2: Customized radiographic assessment stent: 5 mm lead foil strips vertically and 2 mm lead foil strips horizontally attached with cyanoacrylate resin fabricated for Preoperative CBCT.

As conventional drilling technique will result in removal of bone in an already reduced bone volume, lateral compaction with bone expansion was adopted. Also an approach about 1 mm palatal to the mid crest was planned for the pilot drill in this particular clinical situation to preserve the thin labial cortical plate undergoing resorption.

Virtual planning of implant size and position was carried out with measurements respect to the radiographic markers in relation to 21 (Figure 3) and 12 (Figure 4) using 3 shape implant studio software.

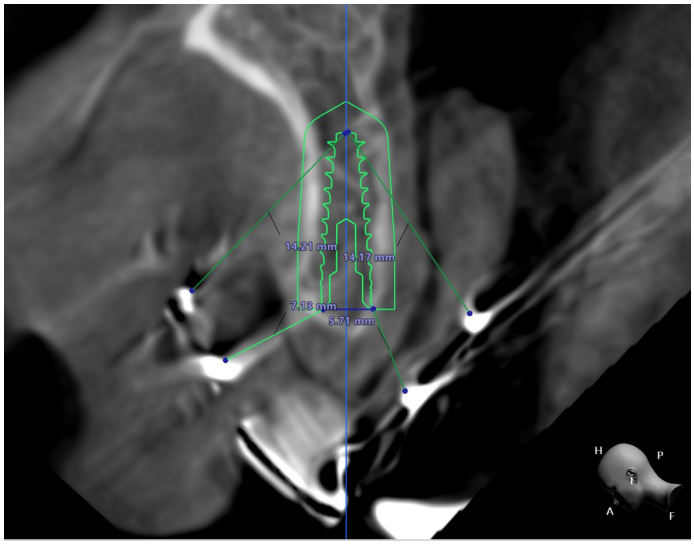

Figure 3: Virtual planning 21: Implant position virtually planned in relation to 21 region with respect to radiographic markers.

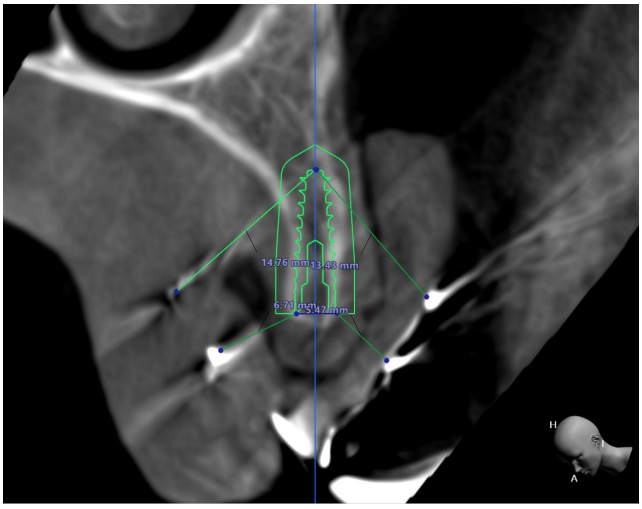

Figure 4: Virtual planning 12: Implant position virtually planned in relation to 12 region with respect to radiographic markers.

Two implants of 3.3 mm × 11.5 mm dimension (Alpha Bio Tec Ltd.,) were decided based on the available bone. The data was exported to laboratory for the fabrication of surgical guide using 3D printing technology. A tooth and tissue supported surgical guide was designed to allow only the use of a 2 mm × 23 mm pilot drill for the palatal approach (Figure 5).

Figure 5: CAD/CAM surgical guide: 3D Printed surgical guide with metal keys for use of 2 mm × 23 mm Pilot drill.

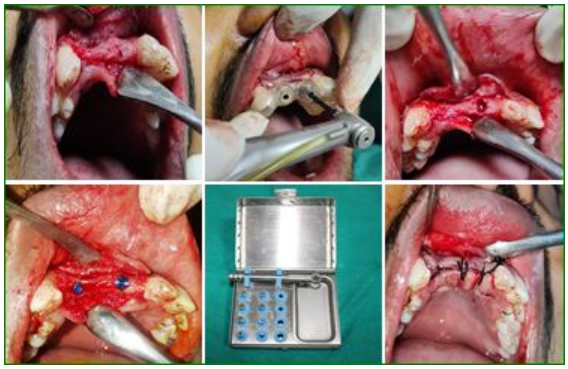

Figure 6: Surgical procedure of Modified Bone expansion technique: Sequential expansion of the atrophic maxillary aesthetic zone with CAD/CAM assisted surgical guide and implant placement using MIS bone expansion kit to achieve the virtual treatment plan.

The patient was administered with 1000 mg of amoxicillin orally 1 hr before the surgical procedure. The surgical guide was placed intra orally and checked for the stability followed by the administration of a 1:1,00,000 concentration local anesthetic solution. A full thickness mucoperiosteal flap reflection was carried out to visualize the buccal bone architecture. The palatal pilot drill was motor driven through the surgical stent. The MIS bone expansion kit was used for the bone spreading technique. The expansion screws were hand driven with a ratchet till the no #2 expander drill according to the manufacturer's expansion protocol. During insertion a waiting period of 20 seconds was maintained for each clockwise rotation with the hand ratchet. The same was made sure during the counter clockwise removal of the expanders. This has been suggested to cause controlled micro fractures of the trabaculae as the bone accommodates the expansion during simultaneous lateral compression [7-9]. The implants were driven with an insertion torque of 35 Ncm to achieve good primary stability and placed 1 mm subcrestally. The labial and palatal cortical plates were intact following the placement of implants. Interrupted sutures were placed to close the flap after placement of healing covers. A Postoperative CBCT was made with the radiographic stent in position and measurements were made to determine the clinical position of implants in relation to 21 (Figure 7) and 12 (Figure 8) respectively.

Figure 7: Clinical evaluation 21: Postoperative CBCT evaluating accuracy of Clinical implants Position in relation to 21 with respect to radiographic markers.

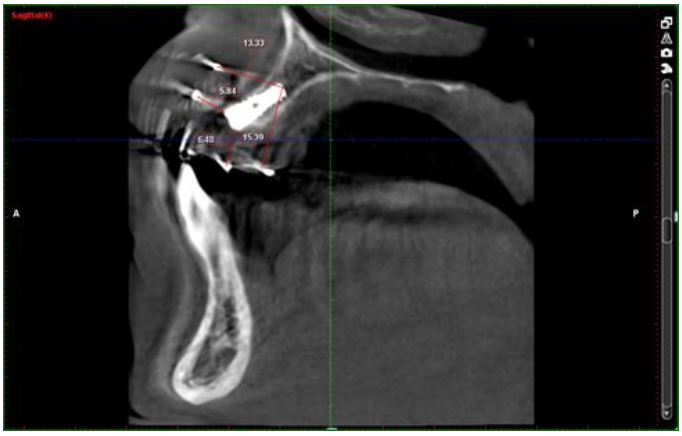

Figure 8: Clinical evaluation 12: Postoperative CBCT evaluating accuracy of Clinical implants Position in relation to 12 with respect to radiographic markers.

DISCUSSION

Historically implant dentistry was driven by the concept of Osseo integration where the position of implant was determined by the presence of adequate volume of bone at the implant site. Modern day implant dentistry is determined by prosthodontically driven treatment planning which focuses on the functional and aesthetic factors to be satisfied by implant retained prosthesis [10].

In the present case report, the deviation of the implant position between the planned and achieved clinical outcome was analyzed with respect to the radiographic markers. The implant irt to 21 showed a difference of 0.2 mm with respect to labial radiographic marker at the apex, 1.4 mm at the labial marker corresponding to the neck, 0.3 mm at the palatal marker to the apex and neck respectively.

Similarly the implant at 12 region varied by 1.43 mm with respect to labial radiographic marker at the apex, 0.87 mm at the labial marker corresponding to the neck, 1.8 mm at the palatal marker to the apex and 1 mm at the neck palatally.

The deviation observed in the above case report can be attributed to the palatal approach combined with the bone expansion technique to prevent the thin labial cortical plate vulnerable to resorption following extraction.

Clinically acceptable position of an implant is considered a zone rather a single point [14]. The facial surface of an implant when more than 2 mm palatal to the planned crown compromises the aesthetics and function. Branemark et al, positioned implants palatally to achieve primary stability. In a retrospective study of 161 palatally positioned implants over a period of 5 years, success rates were 96.9% with a periimplant bone loss of 0.83 mm ± 0.67 mm and healthier soft tissues which was attributed to the conservation of an intact wide buccal bone plate [12]. Similarly In a clinical trial by Pennarocha et al, a success rate of 97.8% was reported for 330 palatally positioned implants with a mean bone loss of 0.61 mm two years post loading and a patient satisfaction score of 9 was recorded on Visual Analog Scale (VAS) [13]. Atrophic ridge with significant amount of type I bone guides expansion towards the least path of resistance due to its pliable nature [15]. This cancellous nature of atrophic bone could lead to marginal errors as the physical properties of bone could not be predicted through virtual planning. Bhargava et al. in 2018 evaluated the bone loss during osteotomy using standard drills, bone trephines and alveolar expanders, it was concluded that there was a clear evidence of lateral condensation of the marrow in the middle third and lower third of the osteotomy length. A general pattern of transition from conservative bone removal at the cortex to pure condensation at the greatest depth of the osteotomy was observed [16]. This shows that with the use of bone expanders more amount of bone gets condensed in the middle and lower thirds of the osteotomy site which could resist the amount of further expansion to achieve the planned position. In an *in vitro* investigation by Abduo et al., although the superiority of the fully guided protocol in the range of 0.5 mm – 1.0 mm was observed, the deviations of the fully guided and pilot guided protocols were clinically tolerable, and the differences between them were not clinically significant [17].

The deviation from the planned position in this case report fits within the ITI recommendations that a 2 mm safety zone should be considered for computer aided implant surgery and that linear measurements on CBCT can be over or underestimated with a range of error of about 1 mm [18].

CONCLUSION

The clinical implant position with radiographic assessment (CBCT) could be achieved within the limits of deviation which is considered clinically acceptable to support a functionally and aesthetically harmonious restoration through a modified bone expansion technique. More clinical trials are required in future to further claim the accuracy of the proposed technique with substantial follow up periods.

CLINICAL SIGNIFICANCE

This case report shows how the modified bone expansion technique with a palatal approach preserve the buccal cortical bone which is vulnerable to resorption following extraction in the maxillary aesthetic zone at the same time achieving the prosthetic driven implant position which is a challenging clinical situation for a restorative dentist.

ACKNOWLEDGEMENT

The authors express sincere thanks to Dr. Shivashankar M and Dr. Gangaiah M for their valuable inputs for this case report.

SOURCE OF FUNDING

This research did not receive any specific grant from the institution, funding agency or any company or manufacturer.

ETHICAL APPROVAL

The study was approved by the ethical committee of the institution with reference no: RRDC&H/PG-04 PROSTHO/ 2018-19.

REFERENCES

1. Moraschini V, Poubel LA, Ferreira VF, Barboza ES. Evaluation of survival and success rates of dental implants reported in longitudinal studies with a follow-up period of at least 10 years: A systematic review. Int J Oral Maxillofac Surg. 2015;44(3):377-88.
2. Albrektsson T, Donos N, Working G. Implant survival and complications. The third EAO consensus conference 2012. Clin Oral Implants Res. 2012;23(Supl6):63-5.
3. Nishioka RS, Souza FÁ. Bone spreading and standardized dilation of horizontally resorbed bone: Technical considerations. Implant dentistry. 2009;18(2):119-125.
4. Andreasi BM, Lopez MA, Andrisani C, Ormanier Z, Gargari M. Full arch rehabilitation in severe maxillary atrophy with palatal approach implant placement: A case report. Oral Implantol. 2016;9(3):115-122.
5. Cortes AR, Cortes DN. Nontraumatic bone expansion for immediate dental implant placement: An analysis of 21 cases. Implant dentistry. 2010;19(2):92-97.
6. Nishioka RS, Souza FA. Bone spreader technique: A preliminary 3-year study. Journal of Oral Implantology. 2009;35(6):289-294.
7. Siddiqui AA, Sosovicka M. Lateral bone condensing and expansion for placement of endosseous dental implants: A new technique. J Oral Implantol. 2006;32(2):87-94.
8. Bassetti MA, Bassetti RG, Bosshardt DD. The alveolar ridge splitting/expansion technique: A systematic review. Clin Oral Implants Res. 2016;27(3):310-24.
9. Al-Almaie S. Osteotome-assisted lateral bone expansion and condensation with immediate dental implants placements. 2017.
10. Cushen SE, Turkyilmaz I. Impact of operator experience on the accuracy of implant placement with stereolithographic surgical templates: an in vitro study. J Prosthet Dent. 2013;109(4):248-254.
11. Schneider D, Marquardt P, Zwahlen M, Jung RE. A systematic review on the accuracy and the clinical outcome of computer-guided template-based implant dentistry. Clin Oral Implants Res. 2009;20(Supl4):73-86.
12. Candel-Marti E, Peñarrocha-Oltra D, Bagán L, Peñarrocha-Diago M, Peñarrocha-Diago M. Palatal positioned implants in severely atrophic maxillae versus conventional implants to support fixed full-arch prostheses: Controlled retrospective study with 5 years of follow-up. Medicina oral patologia oral y cirugia bucal. 2015;20(3):e357-64.
13. Penarrocha M, Carrillo C, Boronat A, Balaguer J, Penarrocha M. Palatal positioning of implants in severely resorbed edentulous maxillae. Int J Oral Maxillofac Implants. 2009;24(3).
14. Kreissel P, Kölpin F, Graef F, Wichmann M, Karl M. Effect of rotating osteotomes on primary implant stability-an in vitro investigation. J Oral Implantol. 2013;39(1):52-7.
15. De VG, Bonino M, Spinelli D, Pozzi A, Barlattani A. Clinical indications, advantages and limits of the expansion-condensing osteotomes technique for the creation of implant bed. Oral Implantol. 2009;2(1):27.
16. Bhargava D, Thomas S, Pandey A, Deshpande A, Mishra SK. Comparative study to evaluate bone loss during osteotomy using standard drill, bone trephine, and alveolar expanders for implant placement. J Indian Prosthodont Soc. 2018;18(3):226-230.
17. Abduo J, Lau D. Accuracy of static computer-assisted implant placement in anterior and posterior sites by clinicians new to implant dentistry: In vitro comparison of fully guided, pilot-guided, and freehand protocols. Int J Implant Dent. 2020;6(10):1-13.
18. Wismeijer D, Joda T, Flügge T, Fokas G, Tahmaseb A, Bechelli D, et al. Group 5 ITI consensus report: Digital technologies. Clinical oral implants research. 2018;29(12):436-42.