Journal of Advances in Medicine and Medical Research

33(7): 81-89, 2021; Article no.JAMMR.66892
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Full Mouth Rehabilitation Using Alveolar Ridge Splitting Technique with Immediate Implant Placement in the Maxilla and Delayed Implant Placement in the Mandible: A Case Report with 4 Years Follow-Up

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Authors' contributions

This work was carried out in collaboration among all authors. Author HAH performed the surgeries and wrote the first draft. Author THS revised the manuscript and author GA designed and correct the final version. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2021/v33i730877
Editor(s):
(1) Dr. Evangelos Marinos, University of Athens, Greece.
Reviewers:
(1) Luca Furlotti, Università di Parma, Italy and Università Vita-Salute San Raffaele, Italy and Istituto Stomatologico Toscano, Italy.
(2) Alessandro Antonelli, University of Catanzaro, Italy.
Complete Peer review History: http://www.sdiarticle4.com/review-history/66892

Case Reports

Received 23 January 2021
Accepted 29 March 2021
Published 03 April 2021

ABSTRACT

The bone split technique is used to increase the width of a narrow ridge for implant placement with high success rates. This technique was performed on a 53-year-old patient with bilateral mandibular posterior edentulous and fully edentulous maxilla. Implants placement was performed afterward with two-step modus operandi on the mandible and immediate placement on maxilla. A successful prosthetic rehabilitation was done following the healing phase. This approach led to full restoration of function and esthetic with a predictable outcome.

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Keywords: Alveolar ridge split technique; alveolar bone atrophy; bone graft.

1. INTRODUCTION

Ridge augmentation could be done by bone block graft, guided bone regeneration (GBR), distraction osteogenesis and alveolar ridge split technique (ARST) or expansion. Tatum (1970s) introduced the ARST or bone spreading [1]. In the 1990s, the ARST became more popular [2-4], and became easier and safer with reduced risk of complications, after introducing piezosurgery [5].

Dental implants are considered to be a convenient treatment modality for edentulism and implant surgery became more and more popular. However, alveolar bone, after tooth loss, often undergoes rapid resorption in some areas and this resulted in bone grafting being needed in almost 80% of the cases [6]. Thus, dentists should be prepared for bone grafting during implant surgery.

To allow a successful implant placement, the volume and quality of both hard and soft tissues need to be ideal. Bone thickness on both vestibular and on palatal or lingual side should be at least 1.5mm or greater [7-9]. As for the width, the alveolar bone has to be superior to 6 mm; otherwise a horizontal bone augmentation is generally required [10].

This report is about a clinical case with horizontal ridge augmentation using ARST with immediate implant placement in the maxilla and delayed placement in the mandible.

2. CASE PRESENTATION

2.1 Patient History and Chief Complaint

A 53-year-old healthy female was referred to our clinic for implants placement. The patient was complaining of compromised mastication and poor esthetics. She has an upper total removable and a lower partial removable acrylic prosthesis.

2.2 Initial Assessment

Thorough oral clinical and radiological examinations were performed. She had a bilateral edentulous posterior mandibular ridge and edentulous maxilla (Fig. 1), with temporary crowns on the anterior inferior teeth 31, 33, 41, 42, and 43. The tooth 32 was missing most likely extracted. Soft tissues, including oral mucosa and periodontal tissues were relatively healthy. The level of supporting bone on the anterior teeth was acceptable as well as the root canal therapy performed. A CBCT was needed to evaluate the volume and quality of alveolar bones in both upper and lower jaws for implant purposes.

2.3 Additional Investigations

The CBCT demonstrated adequate ridge height, but showed a bone thickness of 7-8 mm on 16 and 4-5 mm in the coronal segment of the ridge with progressive apical expansion on 14, 12, 22, 24, 26, 34, 36, 44 and 46, (Fig. 2). The bone quality was type 3 in the maxilla and type 2 in the mandible, according to Lekholm and Zarb classification, with the presence of medullary bone separating the vertical cortical palatal / lingual and vestibular bone [11].

2.4 Diagnostic Decision and Treatment Plan

To satisfy the patient needs, and due to a favorable condition of both soft and hard tissues of the oral cavity, a decision was made for fixed implant supported prostheses on both maxilla and mandible, with separate fixed bridge on the front anterior lower teeth. However, and as the bone volume present a horizontal deficiency in some areas, a bone split procedure was planned with immediate implant placement when possible.

2.5 The Surgical Procedure in the Maxilla

The surgical site was anesthetized using 2% lidocaine, (epinephrine 1: 100,000). A mid-crestal incision was performed and a 4 to 5 mm full thickness flap was raised bucco-palatally using a soft tissue elevator. Consecutively, a ridge splitting procedure was performed using a Piezosurgery® touch unit and the osteotomy kit equipped with inserts OT7, OT7S-4, OT7S-3 (Mectron s.p.a., Genova, Italy). Three cuts were conducted for each implant: a 10mm deep mid crestal cut horizontally on the alveolar ridge, and two vertical cuts on the buccal bone plate starting from the extremities of the first cut. The implant bed preparation started by using a pilot drill with a 2.2mm diameter followed by using the chisels and the ACE Osteotome Bone Expanders (Brockton, MA, USA). Consecutively, the 2.5mm, 3.1 mm and 3.6 mm expanders, taped into the prepared pilot hole to the desired implant length. In the last stage, a final drill with a diameter of

3.6 mm was used to finalize the implant bed preparation. Finally, 6 INNO submerged implants, Cowellmedi (USA Inc.) implants, 4 mm wide and 10mm long, were placed in the sites respective to 16, 14, 12, 22, 24 and 26 (Fig. 3).

Afterwards, all sites were grafted with autogenous bone harvested from the tuberosity using a SafeScraper TWIST (Geistlich Pharma North America Inc.), and covered with a Jason® native pericardium collagen membrane (botiss biomaterials GmbH, Zossen, Germany). In order to achieve tension free wound closure, a periosteal releasing incision was performed to extend the flap in the coronal direction. The wounds were sutured using a 5-0 PGA suture. Postoperative instructions were advised to the patient. Antibiotics (Augmentin 1g) twice a day and analgesics were prescribed for 5 days and chlorhexidine mouth wash 0.2% for 14 days. The sutures were removed after 14 days.

2.6 The Surgical Procedure in the Mandible

Two weeks after the maxillary surgery, the previous surgical site was examined to insure the successful results and the absence of any complication, and the surgical procedure in the mandible was performed. For that, after anesthesia, a mid-crestal horizontal incision and two vertical, vestibular releasing incisions were done and a full-thickness vestibular flap was elevated. The flap was released with a longitudinal periosteal incision from the distal side to the mesial side, avoiding the area of the mental foramen area. Lingually, a full-thickness mucoperiosteal flap was elevated. The mylohyoid muscle insertion, usually located at the level of the first molar area, was detached from the lingual flap by applying a gentle traction force (Fig. 4a). This allowed a stable primary wound closure without tension, avoiding any exposure of the augmented area which could jeopardize the final result.

The bone splitting procedure was performed in the same way as in the previous surgical session. The piezosurgery unit was used to perform the mid-crestal and the two vertical cuts, each side of the implant using a Piezosurgery® touch unit and the osteotomy kit equipped with inserts OT7, OT7S-4, OT7S-3 (Mectron s.p.a., Genova, Italy). Similarly, the bone expander kit was used for bone splitting. However, and due to the low elasticity of the mandibular bone, the buccal plate was separated during bone splitting and lost its stability. It had to be secured with two screws from the Straumann® bone block fixation kit (Basel, Switzerland) and the implant placement was to be delayed for another three months.

Each implant site was filled using a mixture of 50% autogenous bone harvested from the retromolar area, and 50% xenograft bone substitute (BIO-OSS® L); a Jason® native pericardium collagen membrane (botiss biomaterials GmbH, Zossen, Germany) was used to cover the sites, (Fig. 4b-4e).

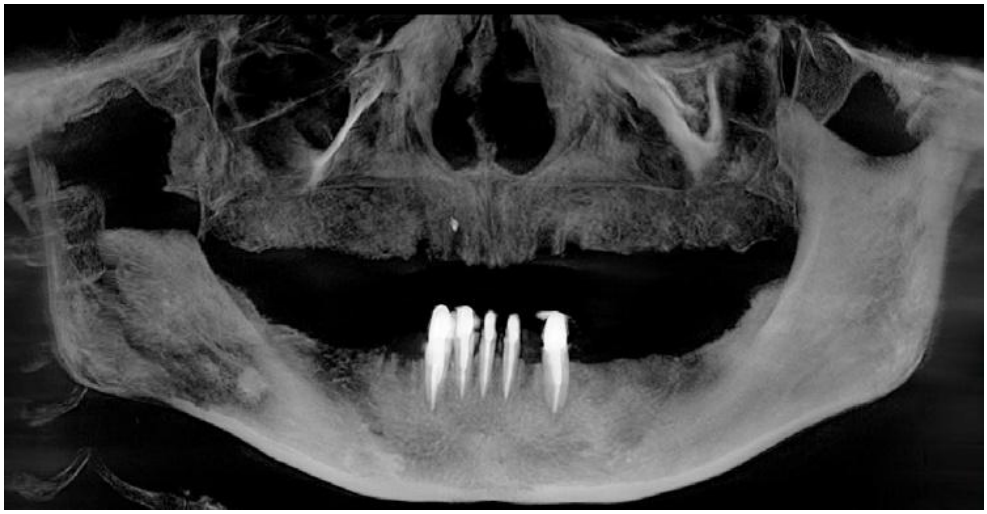

Fig. 1. Preoperative panoramic reconstruction from a cone-beam computed tomography showing maxillary and posterior bilateral mandibular edentulism

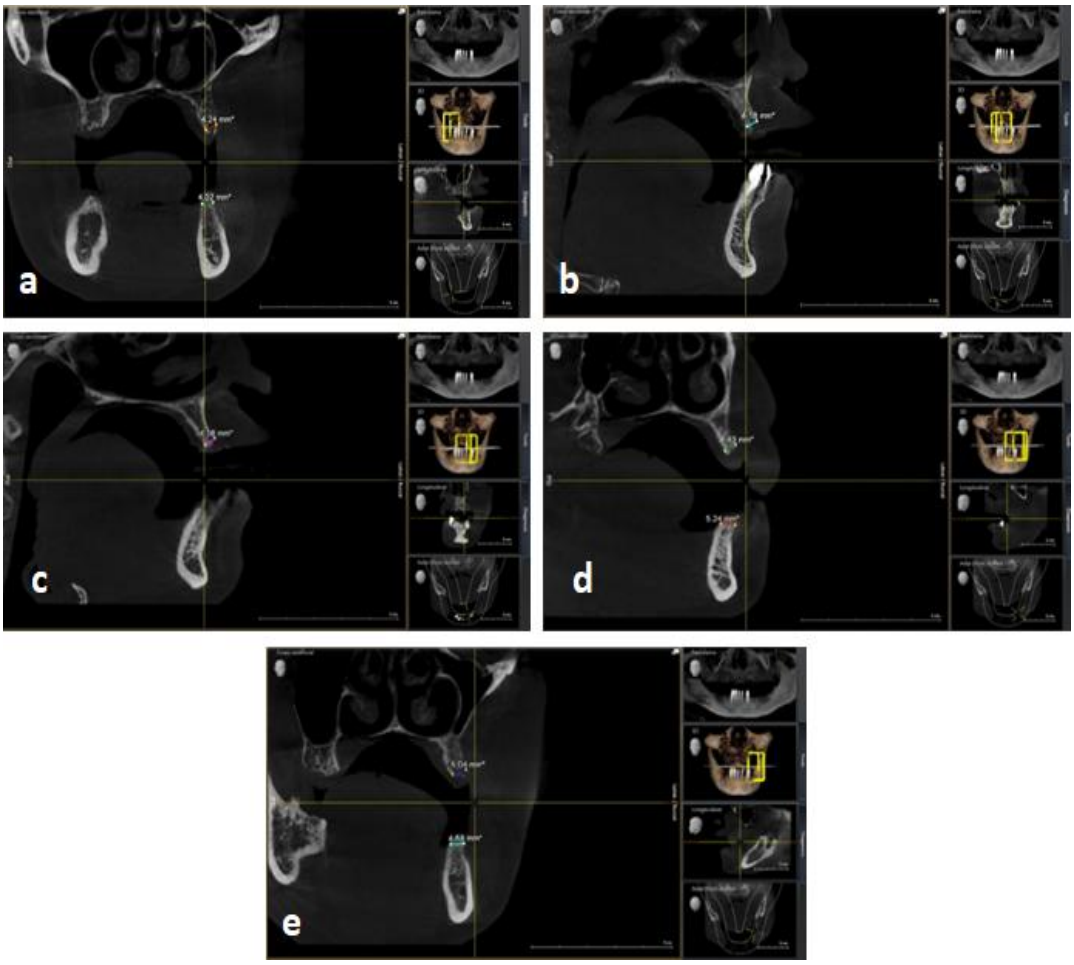

Fig. 2. Preoperative cone beam CT scan showing: a) the bone thickness on 14 and 44; b) the bone thickness on 12; c) the bone thickness on 22; d) the bone thickness on 24 and 34; e) the bone thickness on 26 and 36

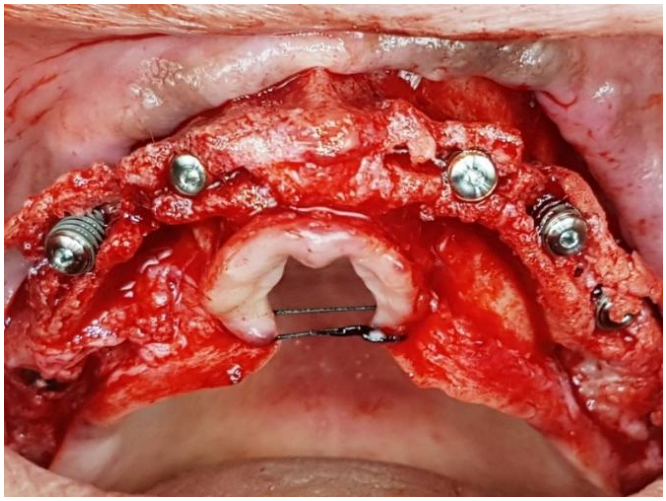

Fig. 3. Implants in place after bone splitting

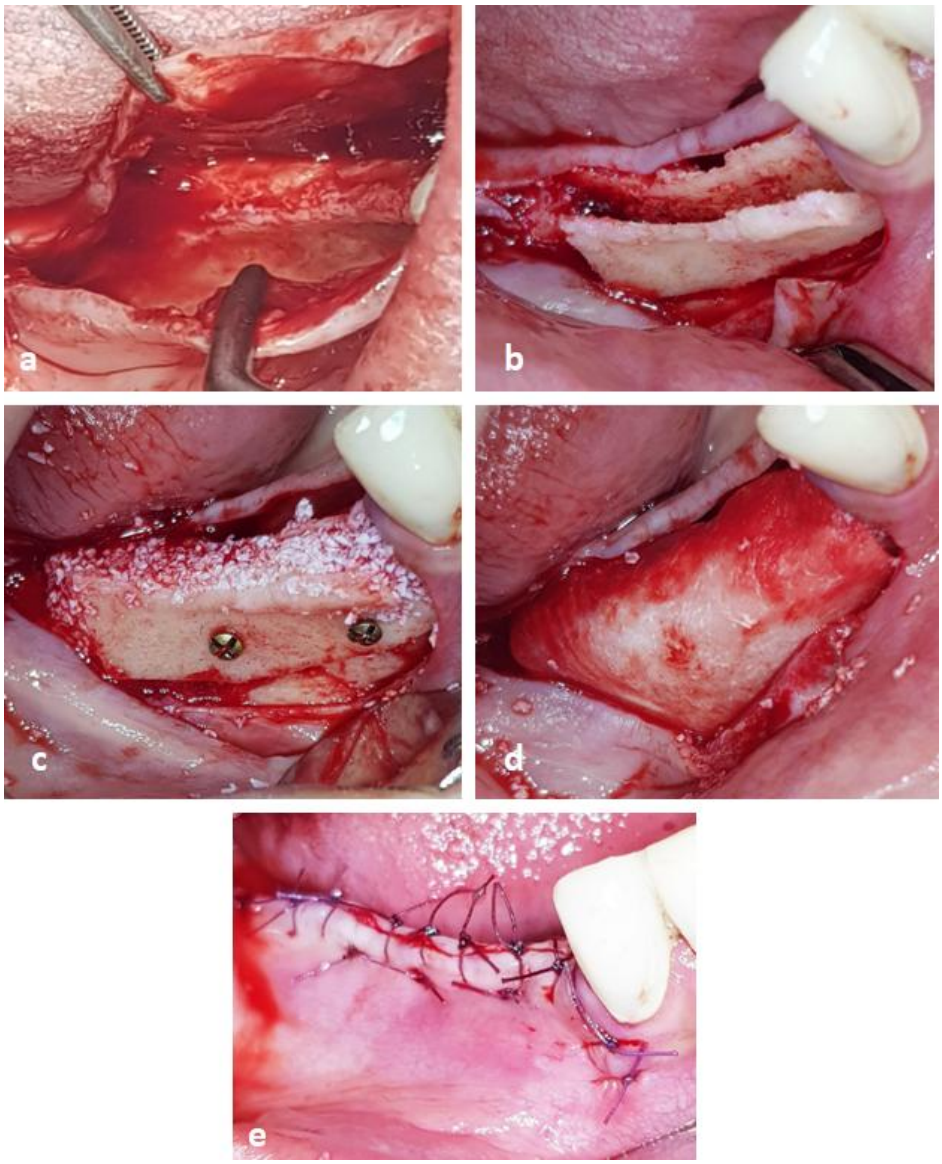

Fig. 4. a) Lingual and vestibular flap after releasing incisions. Note the high mobility of the lingual flap after detachment of the mylohyoid muscle insertion from the lingual flap; b) the alveolar ridge after splitting with piezosurgery; c) after fixating the buccal plate and filling the gap by a mixture of autogenous bone and xenograft; d) a collagen membrane covering the entire defect; e) a combination of horizontal mattress and O sutures to insure the best wound closure

The wounds were sutured using a 5-0 PGA suture. A combination of horizontal mattress and O sutures were performed to insure the best wound closure. The same postoperative instructions were advised to the patient. Sutures were removed after 14 days.

Three months later four INNO submerged implants, Cowellmedi (USA Inc.), 4 mm wide and 10 mm long, were inserted in the sites respective to 46, 45, 34, 36, and healing abutments were placed (Fig. 5).

2.7 Prosthetic Rehabilitation and Follow-Up

Three months after implant placement on the maxilla a temporary prosthesis was fabricated

and two months post implant placement on the mandible (five months after implant placement), the final prosthesis on both maxillae was fabricated and cemented over the implants, (Fig. 6).

For the following 4 years, a regular checkup, including periodontal probing and retroalveolar radiographs, was performed every 6 months the first year and yearly thereafter and the oral hygiene was controlled. A radiological follow-up session four years later showed no bone resorption or inflammation and no other complications. All implants were stable and both prosthetic appliances were completely functional and the patient was satisfied with no complaints (Figs. 7 and 8).

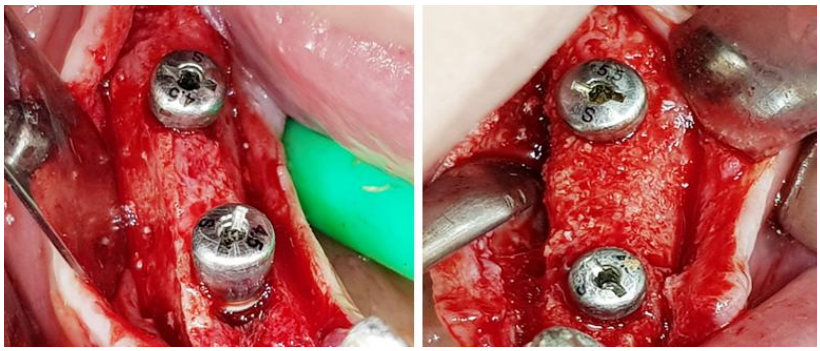

Fig. 5. Three months after the ARST, implants with healing abutments in place on 45, 46 and 34, 36

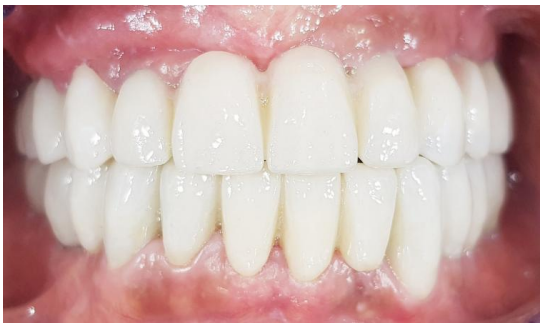

Fig. 6. Final prosthesi

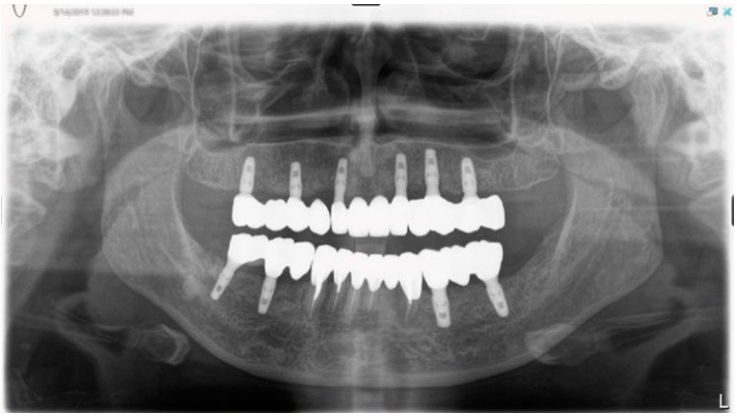

Fig. 7. Panoramic X-ray, after 4 years, showing no bone resorption related to the loaded implants

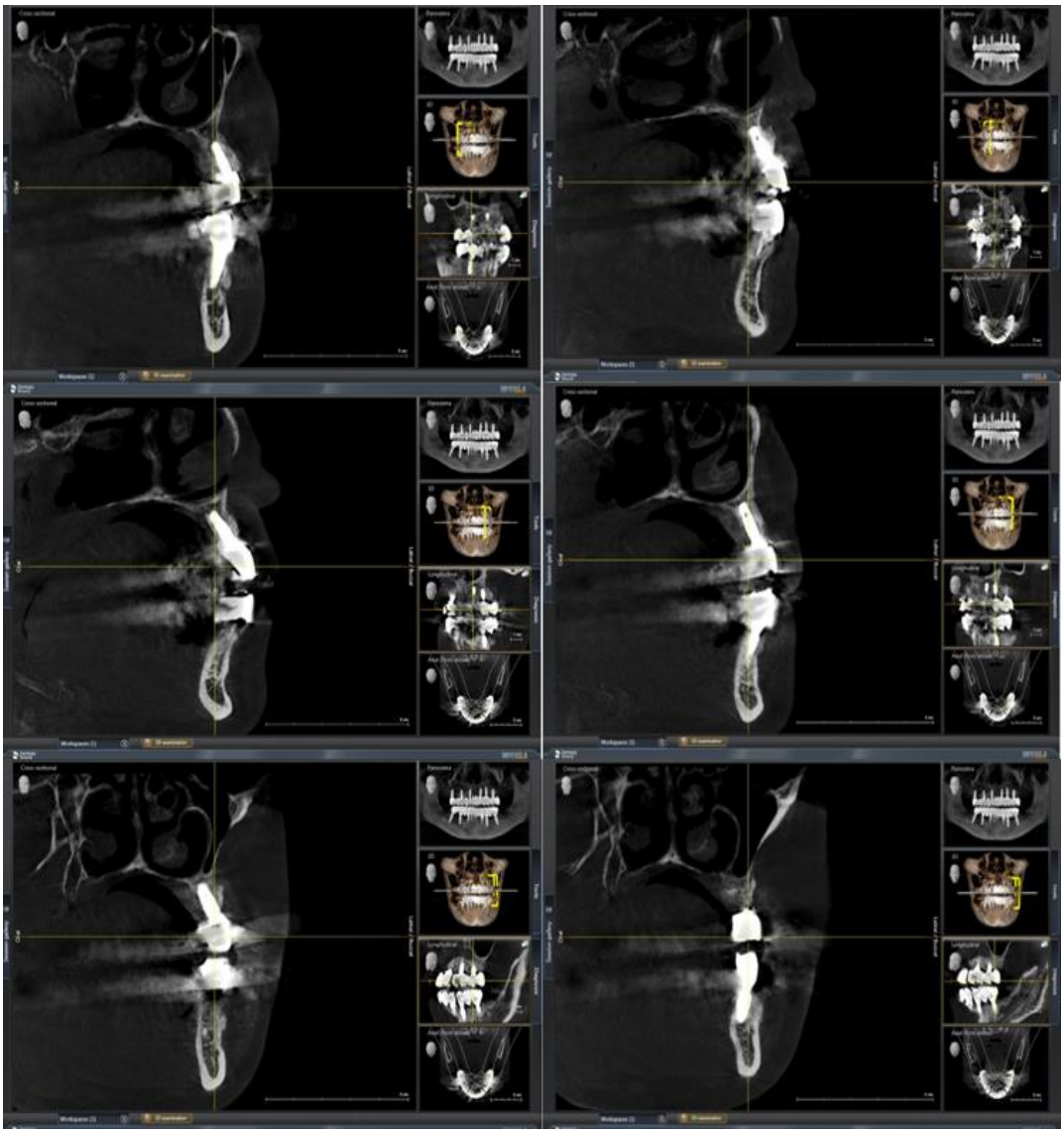

Fig. 8. Cone beam CT Scan (different cuts in different regions) showing the bone thickness

3. DISCUSSION

Studies showed that ARST fulfill all requirements for best bone healing/regeneration of bony defects, such as minimal extent of bone loss, the presence of bony walls, a closed healing environment, space provision and mechanical wound stability [12]. Survival and success rates of implants placed in the expanded ridges are consistent with those of implants placed in non-reconstructed, native bone [13]. Spontaneous ossification, similar to that occurring in fractures and new bone formation permits a consolidation between the oral and buccal bone plates of the alveolus [13]. By reducing the healing period, the ARST offer an important time and financial economy [14,15]. Following this technique, the healing period in this case, was reduced to three months in the maxilla and to five months in the mandible.

However, due to the higher bone density and thicker cortical buccal plate, the mandibular ridges are more difficult treated than maxillary ridges and the risk of buccal plate fracture always exists [13]. The delayed lateral ridge expansion technique should be considered in patients with high bone quality and a narrow ridge in the mandible [16]. In this case, the implants placement in the maxilla was possible

immediately, however, in the mandible, the implants placement was delayed by three months.

The unfavorable inclination of implants represents another limitation. An excessive buccal inclination of implants may create functional and esthetic problems. Guided bone regeneration or bone grafting techniques should be considered in the case of unfavorable bone angularity [13]. In this case angulated prosthetic abutments were used in the anterior maxillary region in order to compensate for the angulation of the implants.

In narrow ridges, a combination of guided bone regeneration with the ARST may prevent post-surgical resorption. A lack of bone substitute resulted in significant resorption of 3- to 4-mm-wide crests [17]. No bone loss was noted in this case, and this could be due to the use of bony grafts covered with collagen membranes [17].

A high success rate and predictable outcomes have been demonstrated by the guided bone regeneration and the lateral ridge split technique [15]; split-crest being a technique that allows the placement of implants in the same surgical act and allows maintaining the patient's cortical bone [18]. This case confirmed that the ARST is a predictable and relatively noninvasive technique to correct narrow edentulous ridges in implant sites.

4. CONCLUSION

This case demonstrated the effectiveness and predictability of the ARST to increase the width of deficient ridges with simultaneous implants placement. Nevertheless, the ARST require a minimum of surgical training, and has limitation concerning alveolar crest width and bone quality. When conducted successfully, the ARST proved to be one of the fast and predictable bone augmentation techniques.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, patient's consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/66892