Sandwich technique for vertical augmentation of atrophic posterior mandible

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Introduction :

A three-dimensionally favourable mandibular bone crest is desirable to be able to successfully implant placement to meet the aesthetic and functional criteria in the implant-prosthetic rehabilitation[1]. The rehabilitation of posterior mandible with dental implants represents today a hard challenge for clinicians due to the lack of supporting bone[2]. In cases of vertical atrophic mandible, the distance to the mandibular canal is an anatomic limitation for rehabilitation with dental implants[1]. Patients can be treated with vertical ridge augmentation, inferior alveolar nerve displacement and the placement of short implants (6mm or less)[2,3].

Several surgical procedures have been advocated for vertical bone augmentation of the atrophic mandible : guided bone regeneration (GBR) , alveolar distraction osteogenesis , onlay bone grafting and interpositional bone graft (sandwich osteotomy).unpredictable resorption of grafted materials are considered in these techniques [1,4]. Vascularity is main factor in determining whether such a graft can be maintained in situ [2].

Harle was the first surgeon to report osteotomy of anterior mandibular ridge sagittaly in order to augmentation of bone[5]. Schetteler split the atrophic alveolar ridge and grafted it [6]. Peterson and Slade modified Harle's technique [7].

The sandwich osteotomy technique vitalised superior bone segment by preservation of lingual periosteum . Segmented bone vascularized by lingual and crestal attached soft tissue.

Piezoelectric surgery is the preferred technique for sandwich osteotomy since it is kind to surrounding tissues such as the lingual periosteum , mentalnerves , and buccal mucosa during surgery . Piezoelectric osteotomy cuts bone with precision and minimizes the bleeding from the site [8,9]. Piezoelectric osteotomy was first described by Jacques and Pierre Curie (1880) [10]. The advantages of piezoelectric surgery are desired shape bone cutting , minimal vital structure damage such as nerve and vessel , reduced heat in surgical site by cavitation and reduced surgical noise [11,12].

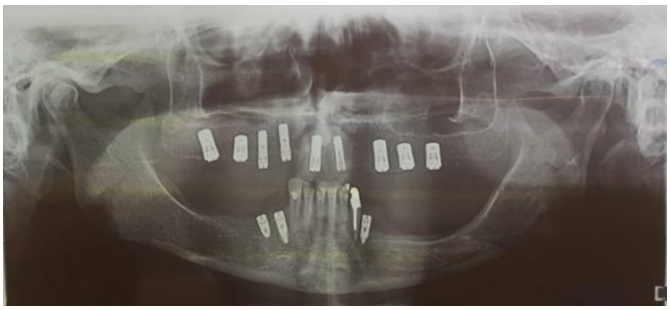
The aim of this report is to investigate the efficacy of the sandwich technique for vertical bone augmentation in the atrophic posterior mandible.

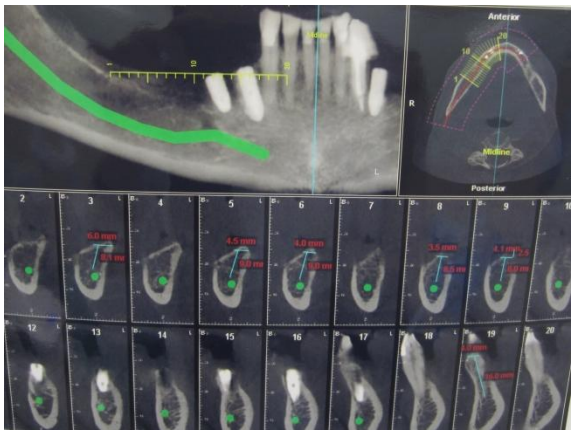
Case report :

A medically stable 51-year-old non smoking woman suffered from edentulous state . The Clinical examination of mandible revealed that severe alveolar bone loss and atrophic soft tissue from the second premolar to the second molar region bilaterally[figure 1] . She was treated with the implant in maxilla and right mandibular premolars and left mandibular first premolar in another center.

Fig. 1 pre op clinical examination , posterior mandible bone loss , atrophic soft tissue feature

Severe atrophy of the posterior mandibular alveolar ridge was observed in both side radiographically . In preoperatory CBCT evaluation , vertical dimension was 4-5mm and horizontal dimension was 7-10 mm (wide ridge) .Crestal bone resorption around implant of mandibular left first premolar was seen. The prognosis was hopeless and should be explanted . [figure 2].

a 

b 

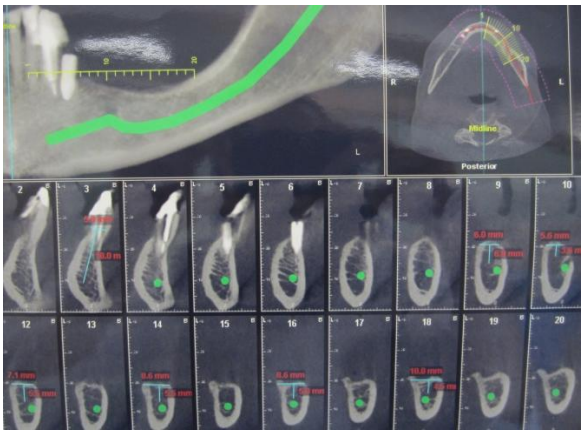
c 

fig.2 pre op radiographic evaluation , a. panoramic view b. CBCT right side c. CBCT left side

The reconstruction plan was vertical augmentation of posterior mandible bilaterally to allow subsequent placement of implants . Atrophied mandible was treated with the sandwich osteotomy technique filled with autologous bone graft harvested by a cortical bone from the lateral oblique ridge and bone block allograft .

Surgical technique :

The reconstruction procedure was performed under local anesthesia with 2% lidocaine and 1:100,000 epinephrine . A full thickness Vestibular incision was made on the edentulous area using a extension to the disto buccal of posterior mandible . Lingual and crestal attachment of gingiva was preserved . it is important to retain crestal and lingual flap due to blood supply of coronal segment . Buccal flap was elevated subperiosteally and the mental nerve was carefully dissected. Also reflection was done slightly toward the crest of the ridge approximately 2mm to expose the vertical osteotomy site .
A osteotomy was conducted using a piezoelectric device to create segmented bone in the atrophic edentulous area . The horizontal osteotomy was made in 1.5–2 mm superior to the IAN and at least 2 mm below to the alveolar bone crest . The segmental mandibular sandwich osteotomy was finished by two (mesial and distal) slightly divergent vertical osteotomies . The mesial cut was performed approximately 2 mm distal to the last tooth and the distal cut was made in accordance with the implant positions .The osteotomies were completed with chisels . The segmented bone was elevated 5-10 mm vertically[figure 3].

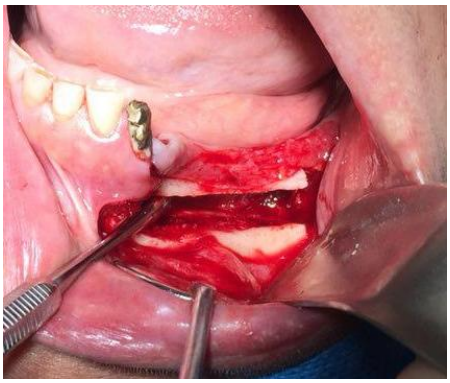


Fig 3. Vestibular incision ,horizontal and vertical osteotomy , preservation of lingual and crestal attachment , segmented bone elevated 7mm superiorly .

Care was taken to maintain the soft tissue pedicle on the lingual surface. If segmented complex was elevated resistibility we could released soft tissue attachment of basal bone gentlely . The entire bone

fragment was displaced cranially, and the desirable position was obtained (transporting the segment attached to the periosteum) .
Interpositional bone block autografts and allografts were inserted in the space between the basal bone and the segmented bone[figure 4].

Fig. 4 interpositional bone block allograft was inserted between segmented bone and basal bone

Autogenous bone block harvested from lateral oblique ridge , crestal bone (posterior of implantation site) and ramus monocortically[figure5] .

Fig. 5 autogenous bone graft harvesting from lateral oblique ridge area

The gaps between the blocks and the native bone were gently filled completely by a mixture of mineralized and demineralized allograft particles and autologous bone chips harvested from the mandible through a cortical bone collector.
Rigid fixation with microplate and screws was performed. Frequently double Y plate was used and inferior screws were monocortical in order to avoid of nerve injury[figure 6] .

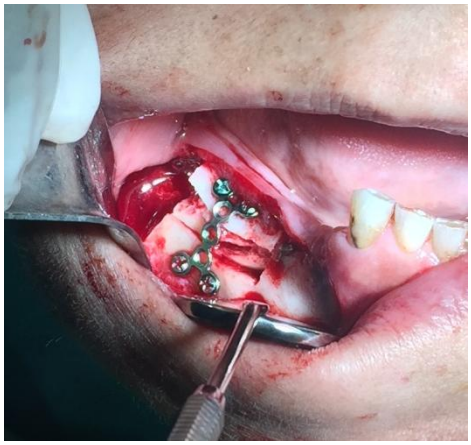


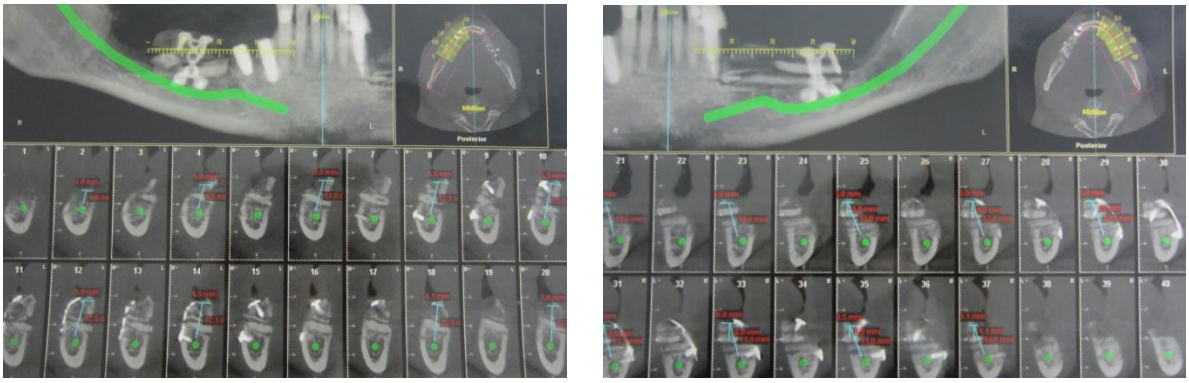
Fig. 6 rigid fixation with microplate

Sometimes one screw was enough for fixation . Collagen membrane used in lingual and buccal aspects . The mucosa was meticulously closed with 4.0 Vicryl mattress sutures. Primary closure was achieved by cross hatching of periosteum of buccal flap .

The patient was prescribed 1gr amoxicillin and 400mgr gelofen before surgery. After surgery patient should be taken 625mg co-amoxiclave q8h for 10 days. The gelofen was taken q6h for 7 days starting at the day of surgery. Postsurgical instructions were a soft diet for 2 weeks and appropriate oral hygiene with twice daily rinsing with a 0.2% chlorhexidine mouth wash. The sutures were removed 7-10 days postoperatively.

Clinical examination was carried out 1 week, 1 month, and 3 months after augmentation including visual examination of the soft tissues for signs of inflammation or infection or suture breakdown and a qualitive evaluation of the oral vestibule and oral hygiene . Sensory changes of lip,chin and lingual were evaluated by touching with a sharp instrument. To evaluate postsurgical changes of both the osteotomized fragment and the interpositional grafts , panoramic view radiography were taken , immediately and 3 months after suregery . The height of the bone gain was assessed [figure 7].

A aa



a b

fig. 7 post op CBCT , a. vertical augmentation of right b. vertical augmentation of left

After a mean 4-month healing period, a cone beam CT was performed and vertical augmentation was assessed. Under local anesthesia crestal incision was performed then plates and screws were removed and implants were placed [figure 8]. 5-10 millimeters of vertical bone gain was achieved by using the sandwich technique[figure 9]. Soft tissue management was considered after implant insertion including FGG.

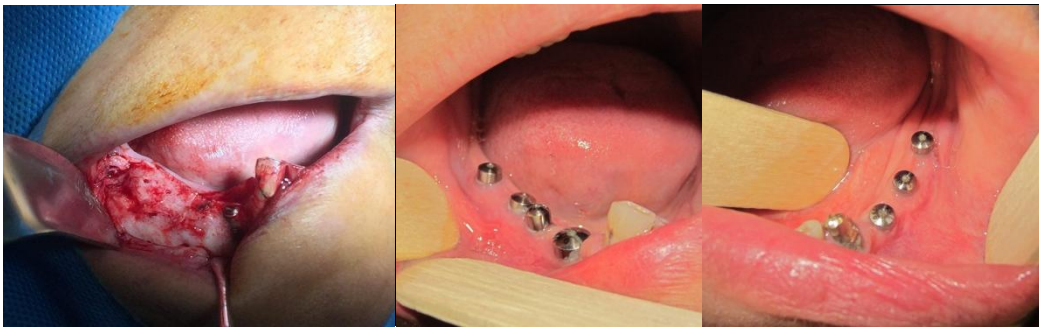


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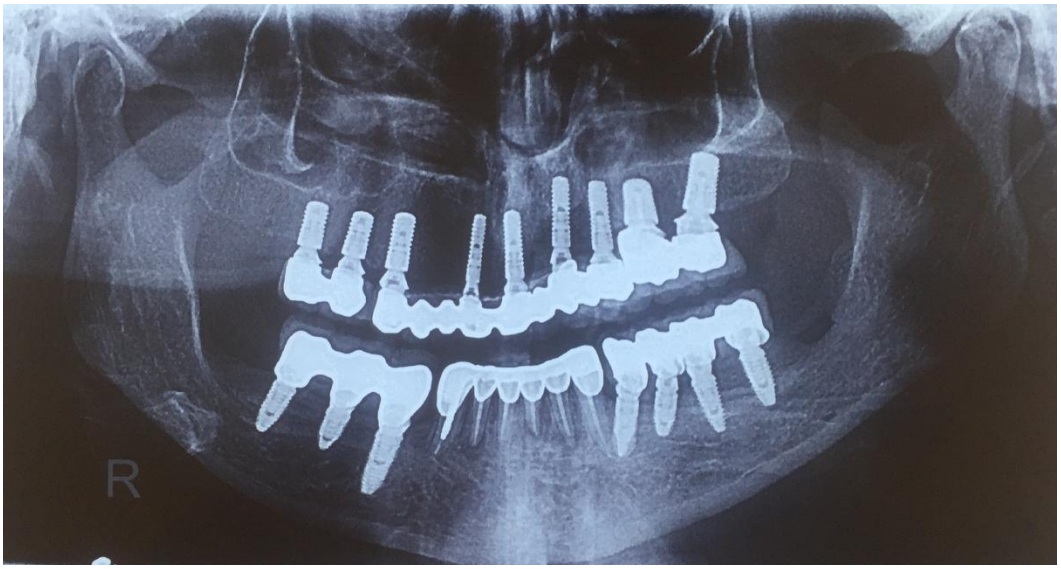
fig8. a. removal of plate and screws , implant placement b. implantation of right side c. implantation of left side , soft tissue around implants was suitable d. prosthesis of right e. prosthesis of left



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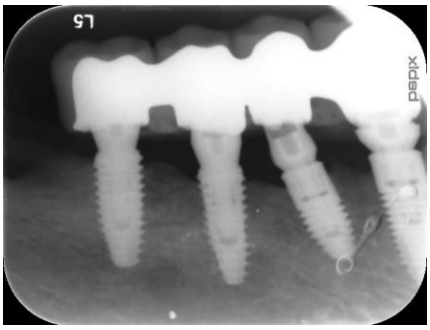

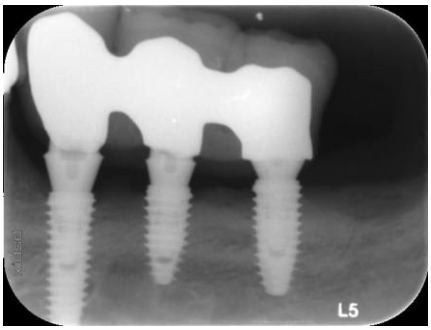

b c

fig.9 radiographic evaluation after 1 year. a.panoramic view b. PA X ray right side c. PA X ray left side

Discussion :

Vertical augmentation of atrophic posterior mandible remains one of the challenging procedure .There are several surgical procedures such as onlay and inlay grafts,[13] guided bone regeneration with a titanium mesh,[14] alveolar distraction osteogenesis,[15] and alveolar nerve transposition [16] for bone augmentation in atrophic mandible.

The Sandwich osteotomy technique with interpositional bone graft is one of the treatment modalities of vertical augmentation. This technique was first described by Schettler and Holtermann in1977 [17]. A lot of surgeons have modified this technique since the late 1970s[18-21].

Politi and Robiony [19] have reported that the interpositional graft technique had more vascular supply to the inlay bone graft than to an onlay bone graft. Jensen et al. [20] stated that the distraction osteogenesis procedure could be effective the same as sandwich technique , but advocated sandwich osteotomy due to its simplicity and bone augmentation (3 to 6 mm of vertical movement). Furthermore , unlike the DO

technique ,sandwich osteotomy has less patient discomfort and does not require high cost associated with a distractor device.
Egbert et al.[21] commented that there is not often an sufficient space to make a sandwich osteotomy without nerve damage because inferior alveolar nerve is located more lingually in many atrophic mandibles. Jensen [20] reported that many patients had some degree of post surgical *transient* paresthesia until six weeks , neurosensory disturbance was likely to be related to flap retraction of the mental nerve. Other studies have shown that fewer cases of dehiscence were observed with the sandwich osteotomy than with techniques using only graft or titanium mesh[2].
Robiony et al. suggest that the superior displacement could be extended more than the 10mm proposed by Jensen, but only in the canine and premolar zones. They stated that the technique can be useful without compromising lingual vascular supply and esthetics [4,19,20,22,23]. In sandwich technique the median vertical gain in the posterior mandible was 6–7 mm [24]. *Bormann KH et al. claim that vertical gain* can reach up to 12 mm[4].
Lingual pedicle was able to maintain the viability of the superior bone segment, allowing to remodel the interpositional autograft [25]. Some studies stated that sandwich technique should only be applied in patients with at least 6 mm of bone above the mandibular canal[24].when using the sandwich osteotomy technique superior bone segment must not be less than 5 mm thick[26]. it is possible to Vitalized superior bone fragment with a height of 2–3 mm. Fixation may be difficult if the bone level above the IAN canal is less than 5mm [15].
Interpositional grafts have the best potential for bone incorporation because the graft is interposed between the basal bone and the osteotomized segment. For this reason, osteoblasts from both sides easily colonize the inlay block. Furthermore, the integrity of the lingual periosteum allows optimal blood supply to the graft reducing its resorption. Therefore, surgical differences between the inlay block technique and GBR and onlay block procedures necessitating the elevation of a lingual flap are evident[27].
Distraction osteogenesis has the greatest potential for vertical augmentation, with reports of a 9.9 mm mean bone gain (range 4–15 mm)[28]. Onlay grafting has been shown to produce considerable resorption[13]. Nerve transposition involves a high risk of permanent neurosensory disturbance[29]. Moonetal.[30]andSohnetal.[31]showed the advantages of piezosurgery for precise control of osteotomy in order to reduce trauma to the inferior alveolar nerve and soft tissue during the procedure (Optimized bloods supply to the superior segmented bone)

Choi etal. [32] demonstrated some crestal bone resorption 1.5mm (18%) to 3.0 mm (28%) after 3 months. In their study fixation was not used. Jensen [20] reported 4 to 8mm of vertical bone gain in atrophic posterior mandible using an autogenous bone graft with no bone resorption. Sohn et al.[31] demonstrated that less resorption of segmented bone was seen in the fixation cases than in the non-fixation cases. Up to10mm of vertical alveolar augmentation can be obtained in the anterior mandible (5–6 year follow-up indicates stable treatment).

Autogenous bon egraft is gold standard for bone augmentation[30,33]. Adequate quantity of autogenous bone is one of the most important limitation .Sometimes surgeon requires a second donor site [34, 35].

Many researchers demonstrate new bone formation after insertion of allografts in bone defects [36-39].

The sandwich osteotomy technique using xenograft material to fill the created gap is safe in both the mandible and the maxilla [40].
In our case autograft and allograft were used simultaneously.

Complication observed were wound dehiscence and graft exposure which are common and relatively less (25% of sites) as compared to onlay bone grafting and similar to that reported in literature[41].

Conclusion :

Radiographic evaluations and clinical healing demonstrate the effectiveness of this technique to obtain safe and precise osteotomies. Segmental mandibular sandwich osteotomy is an easy and safety technique that could be performed in an atrophic posterior ma

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