



# Highly Predictable Augmentation of the Alveolar Ridge: Using a Ribbed Titanium Mesh in Two-Stage Implant Surgery at the Mandible. Report of Clinical Cases and Surgical Technique\*

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## ABOUT ARTICLE

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## ABSTRACT

### Purpose.

The aim of this prospective surgical note was to evaluate the highly predictable horizontal bone gain of the alveolar ridge augmentation in two-stage implant surgery at the mandible with titanium mesh.

### Material and Methods.

Five patients treated with 10 implants and simultaneous guided bone regeneration with ribbed titanium meshes (i-Gen®, MegaGen, Seoul, Republic of Korea) were selected for inclusion in the present surgical note. Primary outcomes were highly predictable horizontal bone gain of the alveolar ridge augmentation, secondary outcomes were biological and prosthetic complications.

### Results.

After the removal of titanium meshes, the cone beam computed tomography (CBCT) showed a mean horizontal bone gain of 2 mm. The most frequent complications were mild postoperative edema (40% of patients) and discomfort after surgery (60% of patients); these complications were resolved within one week. Titanium mesh exposure occurred in 0 patients. And implant survival rate of 100% (implant-based).

### Conclusions.

The horizontal ridge reconstruction with titanium meshes placed simultaneously with dental implants achieved predictable satisfactory results.

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## Introduction

In our opinion the best way to restore partially dentition defect for nowadays is dental implantation.

Dental implants are a predictable treatment procedure for the prosthetic rehabilitation of partially and fully edentulous patients [1–3]. But there is a lot of cases in our everyday practice (35%) that seems with CBCT not an adequate bone volume to place implants.

An adequate bone volume is required for insertion of dental implants [4, 5]; the absence of a sufficient amount

of horizontal and vertical bone is a problem that can affect the survival and success rates of dental implants in the short, medium, and long term [4, 5]. Since frequently patients present with bone defects of variable entity [4, 5], different surgical techniques have been proposed to restore the ideal anatomical conditions required for implant insertion or to allow simultaneously positioned implants to succeed [6–14]. These techniques include onlay/inlay bone grafting [6, 7], distraction osteogenesis [8], maxillary sinus augmentation [9], inferior alveolar nerve transposition [10], alveolar ridge split [11], and guided bone regeneration (GBR) with resorbable [12] and nonresorbable membranes, such as those in polytetrafluoroethylene (PTFE) [13] or titanium [14], partial extraction therapies [28]. GBR is considered one of the most predictable of these techniques in terms of clinical outcomes, as reported by several systematic reviews of the literature [12–15], particularly where it is employed for the regeneration of defects of small and

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medium entities [16], or around dental implants [17]. The operating principle of GBR involves the placement of a mechanical barrier for the protection of the clot and the isolation of the bone defect from the surrounding connective tissues, in order to facilitate the selective recruitment of the mesenchymal cells responsible for new bone formation [12-15, 17]: this can allow the regeneration of the bone defect.

Bone regeneration with GBR has been demonstrated to be predictable, whether or not biomaterials are positioned below the membrane and are contained by it [12, 14, 16].

An ideal membrane should possess the following characteristics: biocompatibility, space maintenance capabilities, and ease of use [13, 14, 17, 18]. In the last few years, several types of membranes with different designs have been introduced, to facilitate the containment of the regenerative material that is often positioned below it and to prevent its dispersion, but also to simplify the work of the surgeon and the application of the membrane itself [13-18].

In particular, the titanium meshes represent a valid solution, because they meet most of the ideal requirements that a membrane should possess [14, 15]. Several clinical

studies have demonstrated that titanium meshes can promote the formation of new bone, when positioned before [19-24] or simultaneously with dental implants [25-27].

The proper placement and stabilization of the titanium mesh into the defect site is of fundamental importance for the success of the regenerative therapy [13, 16-18]; one of the difficulties with these membranes can be related to this, particularly in case of simultaneous placement of the implant, for regeneration of small and medium size defects [17, 18, 25-27].

Recently, titanium meshes that can be fixed directly on the implant have been introduced, but there is still a lack of clinical studies evaluating the efficiency and predictability of these membranes [18, 26].

Therefore, the purposes of the report are 1) to evaluate the horizontal bone gain and the degree of complications in patients treated with titanium meshes positioned simultaneously with dental implants and fixed over them 2) to give for colleagues a new approach for the bone augmentation technique.

In our clinical cases (target group) there were five missed tooth 3.6 (Fig 1) for some years with vestibular horizontal bone atrophy, that we examined on CBCT (Fig 2).



FIGURE 1. Preoperative clinical view in an area of a loosened tooth 3.6.



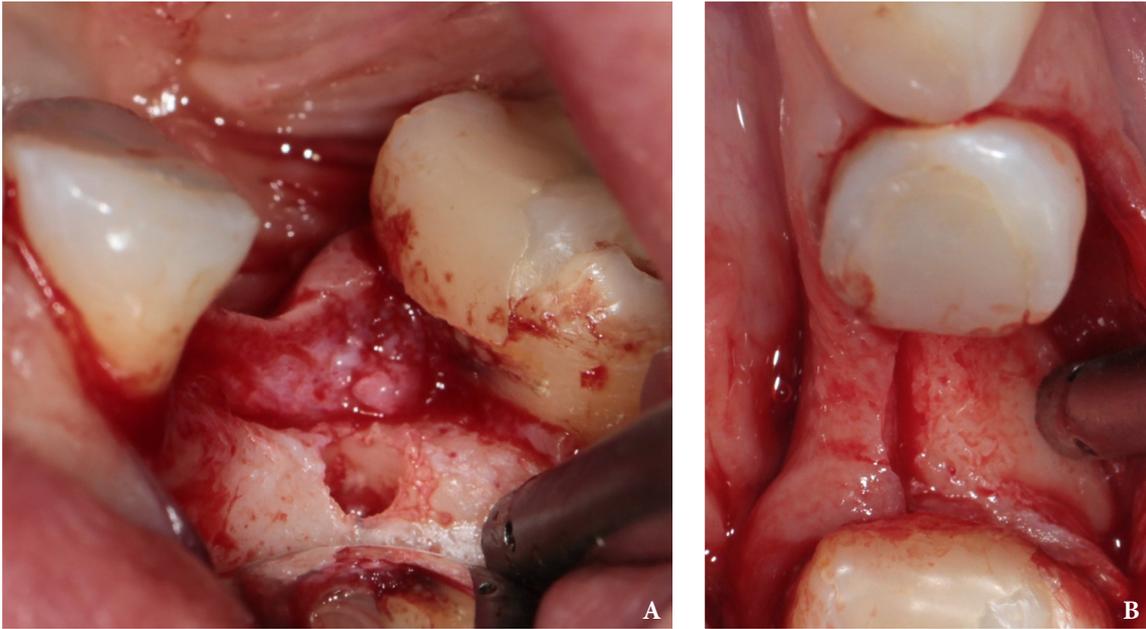
**FIGURE 2.** Preoperative cone beam computed tomography (CBCT). 3D reconstructed (A), coronal (B: Buc = buccal side, Lin = lingual side.), and axial (C) scans of the mandibular bone in are of missed tooth 3.6.

We prefer to restore this partial edentulous using implant placement (AnyOne; MegaGen, Seoul, Republic of Korea) with GBR (Laddec; OST Développement, Clermont-

Ferrand, France) and titanium mesh i-Gen (MegaGen, Seoul, Republic of Korea) (Fig 3) to achieve predictable vestibular bone gain before the implants and do one step surgery.



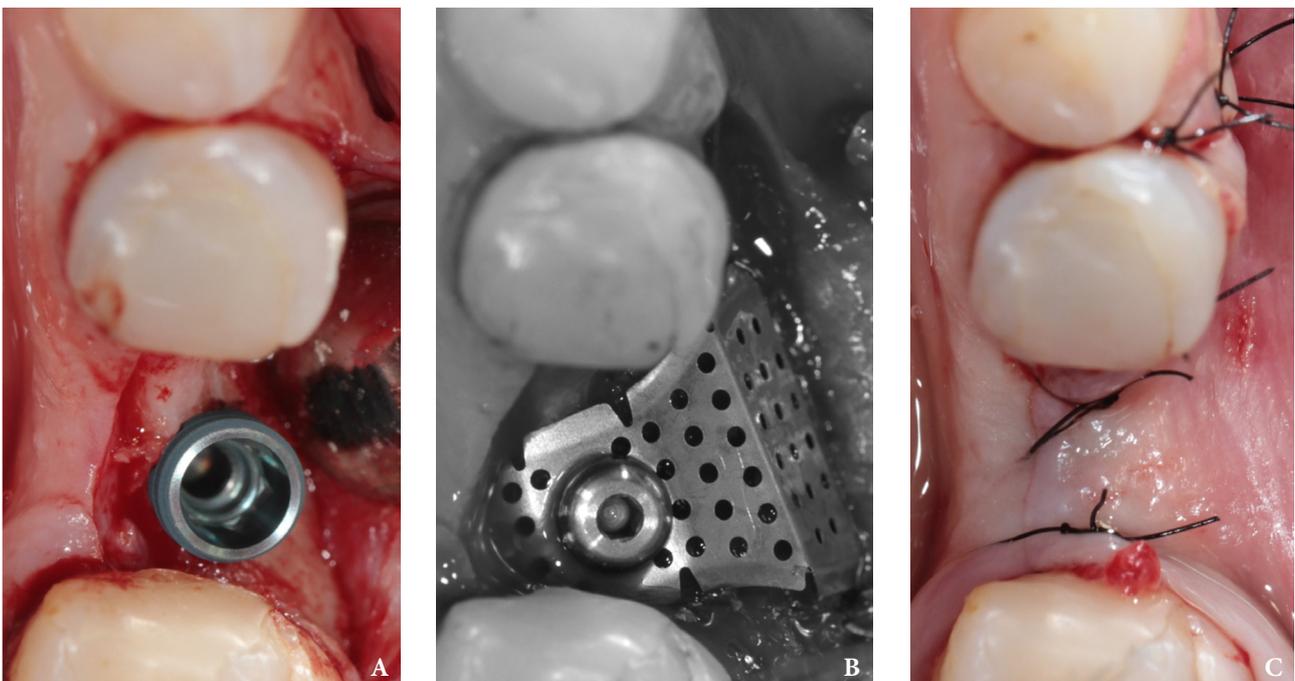
**FIGURE 3.** Ribbed titanium mesh before bone augmentation surgery at mandible.



**FIGURE 4.** Elevation of full-thickness flap exposing the deficient alveolar ridge (A, B). Preparation of the surgical site.

Surgical procedures begins with local anesthesia and incision (one crestal and two horizontal). Full-thickness flap to expose the residual bone (Fig 4). Osteotomy starting with a 2.0 mm diameter pilot drill, then protocol preparation for implant site we choose (4.0-10, 4.0-11.5, 4.5-10 AnyOne) (Fig 5A). Implant placement. Osteotomy of the cortical bone. Regenerative material (Laddec; OST Développement, Clermont-Ferrand, France) filled the vestibular bone defect and covered with advanced platelet

rich fibrin (APRF) [22] and a ribbed titanium mesh (Fig 5B) is fixing on implant with screw (i-Gen; MegaGen, Seoul, Republic of Korea). APRF was achieved using Choukroun A-PRF Centrifuge System (A-PRF™; Nice, France). The soft tissues were adapted over the membranes with mobilizing the flap, sutured with horizontal mattress and single loop sutures (Nylon 5.0, RE-SORBA Medical GmbH, Germany) (Fig 5C). Postoperative and 1-week recommendations were given.

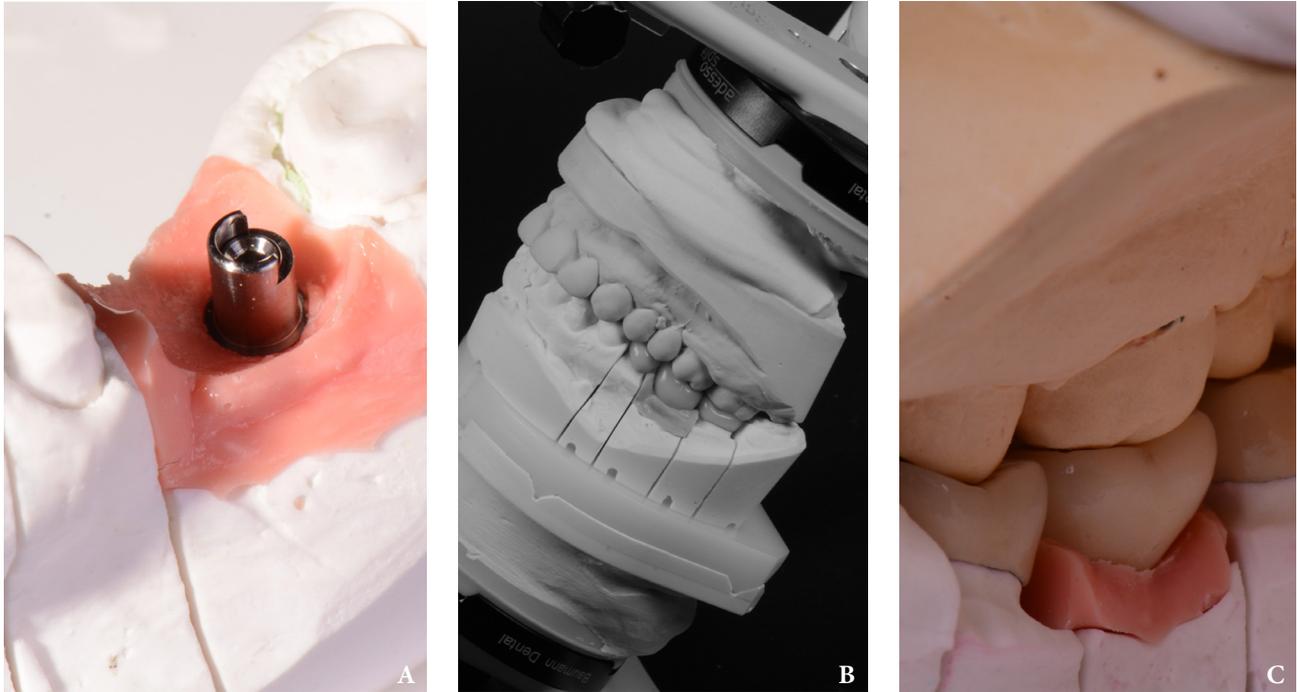


**FIGURE 5.** Placement the implant (A), titanium mesh (B), and sutures (C). The titanium meshes are connected to the implants and screwed on with the aid of a connecting screw; particulate bone grafts are placed below the titanium mesh screwed on implant.

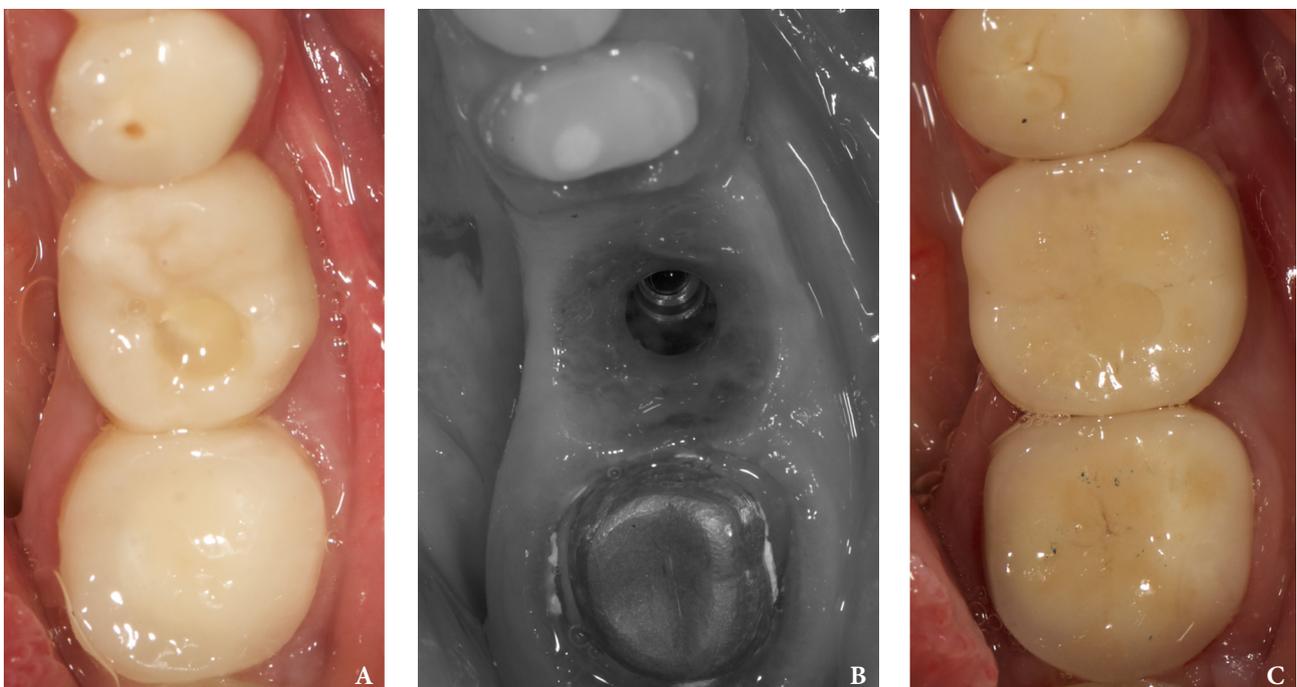
## HIGHLY PREDICTABLE JAW AUGMENTATION TECHNIQUE

After 3 months, a second stage surgery was performed at the recipient sites. The fixtures were uncovered, and the titanium screws and meshes were removed; transmucosal healing abutments were positioned and sutures were performed

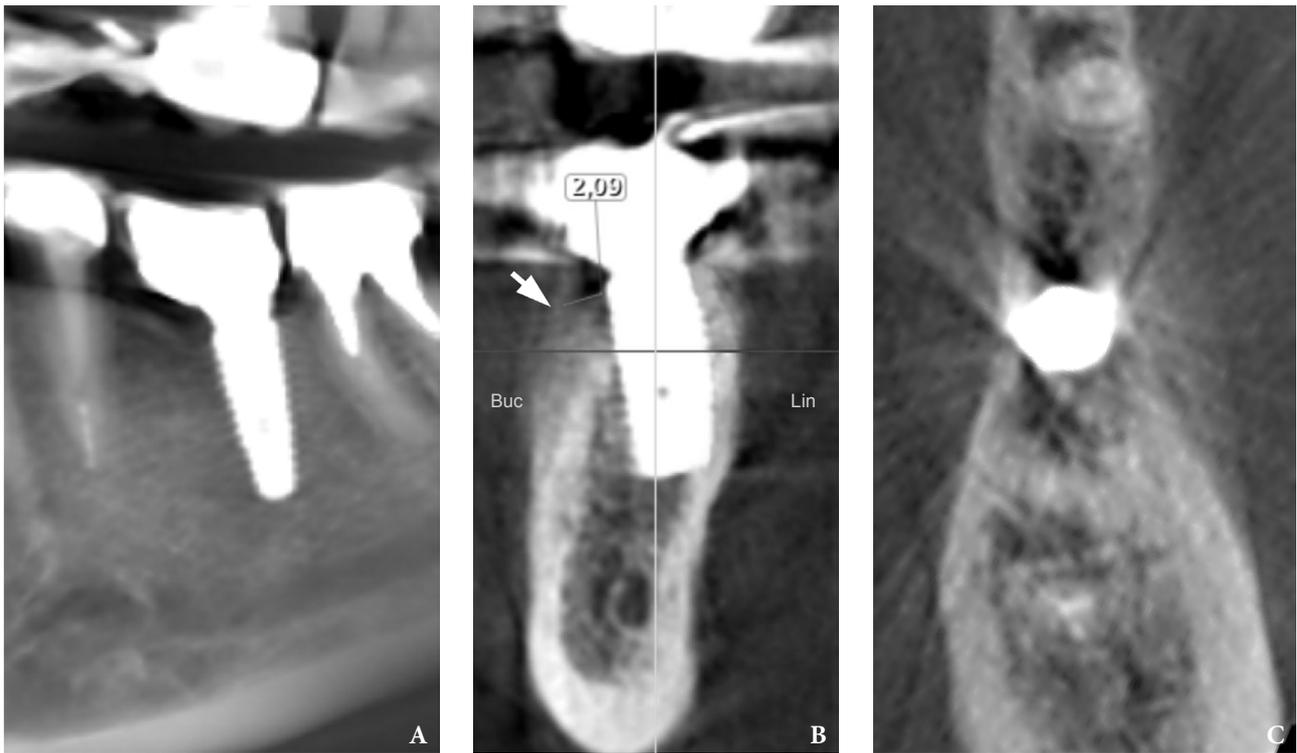
around them. Two weeks later, impressions were taken, and temporary resin restorations (single crowns, screw-retained) were provided (Fig 6). 1-month later we fixed ceram-zirconia screw retained crowns on titanium-bases (Ti-bases) (Fig 7).



**FIGURE 6.** Consecutive stages (A-C) of the laboratory workflow.



**FIGURE 7.** View of temporaries (A), emergence profile in keratinized gingiva (B), and fixed cream-zirconia screw retained crown (C).



**FIGURE 8.** CBCT scans (**A**: panoramic view; **B**: coronal scan; **C**: coronal scan) with the highly predictable horizontal modeling of alveolar ridge, 4 months after surgery. (**B**) Buc = buccal side, Lin = lingual side. Noted additional 2.09 mm new bone (*arrow*) at the vestibular side of the implant (at the level of its cervical portion).



**FIGURE 9.** The view before (**A**) and after rehabilitation with permanent crown 4.5-month postoperatively (**B**).

## PRIMARY OUTCOMES

Early biological complications: early complications were those that occurred immediately after surgery, or in the immediate aftermath (1-2 weeks), such as pain/discomfort, swelling/edema, and extraoral contusion. No one mesh exposure [22] on regenerative stage we fixed using special design form meshes (i-Gen, MegaGen, Korea).

## SECONDARY OUTCOMES

The highly predictable horizontal augmentation of alveolar ridge were measured in the CBCT sections (in mm), 4 months after surgery we done (Fig 8). Pre- and postop clinical photographs (Fig 9) clearly demonstrate very precise result.

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## Conflict of Interests

The authors declare no conflict of interest.

## Role of Author and Co-authors

Oleg I. Mastakov (material collection, concept of the paper and writing)

Bohdan R. Kondratiuk (material collection)

Anna I. An (material collection)

Ievgen I. Fesenko (editing)

## Patient consent

Written patient consent was obtained to publish the clinical photographs.

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