

One-Time Cortical Lamina: A New Technique for Horizontal Ridge Augmentation. A Case Series

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ABSTRACT

The aim of this case series is to introduce the One-Time Cortical Lamina Technique, a simplification of the F.I.R.S.T. (Fibrinogen-Induced Regeneration Sealing Technique) in cases where only horizontal augmentation is needed. The indications for this technique are ASA2 and ASA1 anxious patients. Pre-requisites for this surgical technique are: a good amount of keratinized tissue, sufficient alveolar ridge width for placement of implants, thickness of vestibular bone at CBCT planning less than 1 mm with risk of threads exposure. Five patients with horizontal deficiencies were selected to test the efficacy of this approach. The defects were augmented using a porcine cortical bone lamina in combination with collagenated porcine bone mixed with fibrin sealant. The cortical lamina was placed only buccal to the implants and stabilized with fibrin sealant, without pins or screws. Upon completion of the implant surgery, healing abutments were connected to the implants and the soft tissue sutured around them. The healing was uneventful in all cases. Six months after surgery impressions for final restorations were taken and screwed crowns delivered. The new volume had hard consistency and the follow-up CBCT measured an average of 4.17 mm of horizontal bone augmentation. One to three years of follow up demonstrated the maintenance of vestibular volume, hard consistency and clinical stability. Intraoral X-rays showed no marginal bone loss. An advantage of this technique could be the one stage surgery that creates a stable environment for regeneration from day one.

Keywords: Cortical lamina; Fibrin sealant; F.I.R.S.T.; Guided bone regeneration

INTRODUCTION

Horizontal bone loss or remodeling of the alveolar ridge and subsequent lack of adequate width for optimal implant placement is a frequent situation happening after the loss of permanent teeth. Other factors that may result in alveolar deficiencies include physiologic bone resorption, trauma, congenitally missing teeth, periodontal disease, etc. The literature, throughout the years, has presented a variety of techniques and combinations of materials in an attempt to find the most effective and predictable mean for ridge augmentation. The objective of this paper is to focus on a one stage technique that could represent a significant simplification for both

patients and clinicians. The technique presented in this paper is a modification of the F.I.R.S.T. introduced by Foti and Rossi in 2020.¹⁶

Fibrin sealant

Fibrin sealant (FS) is a drug derived from human blood, used in surgery and in specialties since 1975 for his hemostatic and adhesive properties. The first application in the dental field dates to the 80', in oral surgery for those patients with hemostasis disorders.¹ In regenerative procedures, FS adds an excellent physical quality to the bone grafts, making them sticky, moldable and easy to adapt to local anatomy, without any waste of granules.² Corrente G et al. introduced in 1997 a new peri-implant regenerative technique by adding the FS to a bone graft.³ The authors achieved supra-crestal bone regeneration without the use of a barrier membrane. The average vertical gain was 2.05 mm and histology showed newly formed trabecular bone.³ Cardaropoli D et al.⁴ in 2013 modified the technique of Corrente by adding a collagen membrane. With this addition they reported a mean vertical gain of 3.95 mm.⁴ FS demonstrated an osteoinductive capacity when mixed with osteoconductive biomaterials.^{5,6} FS favors angiogenesis, thanks to the link of fibrinogen with VEGF growth factor, stimulating proliferation of endothelial cells.⁷ Fibrinogen also induces the formation of extracellular matrix to support blood supply, connective tissue and bone.⁸ Linsley C et Al. in 2012 demonstrated that fibrinogen induces growth of mesenchymal cells and their differentiation into osteoblasts.⁹ One last effect of FS is to enhance and accelerate wound healing and wound closure.¹⁰

Cortical lamina

The cortical lamina technique has been introduced nine years ago and both clinical and histological studies have validated its use in GBR. The cortical lamina is a membrane made of collagenated porcine bone used to stabilize a collagenated porcine bone graft. Biopsies taken after its application showed that all areas augmented had live mineralized bone.¹¹⁻¹³ The soft lamina behaves like any resorbable membrane but, being made of bone, when is bent has elastic memory and needs to be fixed by pins or screws. Whenever an early exposure of cortical lamina happens, it is a completely different pattern of healing compared to other non-resorbable barriers. The cortical lamina when exposed to saliva and oral enzymes, depending on individual situations, either hydrolyzes and slowly melts or remains exposed while the soft tissue granulates around it. The morbidity of the procedure is very low and the rate of complications reported minimal.¹⁴

F.I.R.S.T.

Since the stability of the bone graft during the early phase of healing is one of most important key factors for success in GBR¹⁵, Foti V. and Rossi R. introduced in 2020, after four years of clinical applications, the Fibrinogen-Induced Regeneration Sealing Technique (F.I.R.S.T.)¹⁶ for horizontal ridge augmentation that showed an improved stabilization of the biomaterials adding FS to the collagenated porcine bone, same as Corrente technique, in this case the graft stabilized with the addition of FS was protected by gluing a soft lamina on top of it. The lamina would be glued first in its lingual aspect and once firmly attached to the underlying bone graft was also glued to the buccal and coronal aspect of the area needing augmentation. The histological findings at 6 months demonstrated newly formed trabecular bone and osteoid matrix in close contact with residual particles of biomaterial. The CBCT after 4 years showed a new cortical bone, the horizontal volume was maintained and the overall augmented area showed great stability.

One-time cortical lamina

This case series introduces One-Time Cortical Lamina Technique, a modification of the F.I.R.S.T. for a one step horizontal bone augmentation.

METHOD AND MATERIALS

Five patients, 55 to 82 years old (three women and two men), were selected. Each patient demonstrated a localized reduction of alveolar ridge width and a need for dental implants in the posterior maxilla and in posterior mandible. All patients fulfilled the following inclusion criteria: the site presented adequate keratinized tissue (Fig 1A), the alveolar ridge width was sufficient for immediate implant placement, the facial bone thickness was less than 1 mm at CBCT planning with risk of threads exposure (Fig 2). All patients were nonsmokers, three ASA2 and two ASA1 anxious, and had no contraindications for GBR procedures. The patients were clinically and radiographically examined with intraoral X-ray (Digora Optime, Soredex, Tuusula, Finland) and CBCT (Planmeca Viso G7, Helsinki, Finland). The software had measurements resolution of 0.15 mm (Romexis 3.8.3. R, Planmeca, Helsinki, Finland). The preparation consisted of scaling, root planing and oral hygiene instruction two weeks before the surgery.



Fig 1 A: Partial edentulism with adequate amount of keratinized tissue. B: Modified removable prosthesis with anterior bite. C: The prosthesis sits on the teeth and does not apply compression to the area of grafting

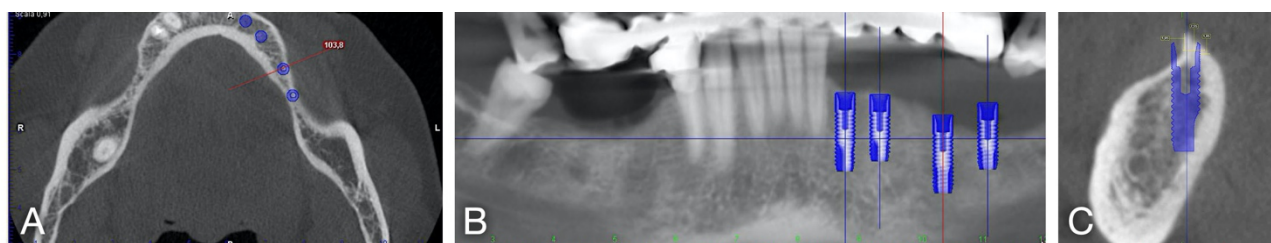


Fig 2 A: Axial section focused on site 36. B: Planning includes a temporary implant on site 37 support temporary denture. C: Exposed threads of virtual implant on site 36.

Surgical procedure

After local anesthesia with 4% Articaine with 1:200,000 adrenaline, a lingual crestal incision was performed and a full-thickness vestibular flap was elevated with one only vertical incision distal to papilla of the canine (Fig 3A). Since the flap displaced from the lingual aspect to the vestibule, passivation was not necessary. Ten implants TSIII SA (Osstem, Seoul, South Korea) of 3.5 mm diameter were placed with primary stability. Seven implant sites needed bone augmentation because the buccal bone was concave, very thin and some coronal threads were exposed. Healing abutments of 4 mm height were connected to the implants. After hydration

for 5 minutes in sterile saline solution, a 25x25mm cortical lamina of 0.5 mm thickness (Soft Fine Cortical Lamina Osteobiol By Tecnos, Coazze, Italy) was cut to size and tested on the vestibular wall. After 1:10 dilution of the thrombin component with sterile double distilled water, a few drops of FS (Tisseel, Baxter, Rome, Italy) were applied to a collagenated porcine graft (GenOs, Osteobiol by Tecnos, Coazze, Italy). The mixture was applied to the vestibular aspect of the implants thus creating a new overcontoured anatomy. After five minutes the graft, stable and well adapted to the defect (without waste of granules), achieved a consistency similar to play dough. FS was then applied to the cortical lamina before it was adapted on top of the grafted. The lamina was firmly attached to the local anatomy without the need of pins or sutures (Fig 3B). The surgery ended fixing the keratinized tissue without tension with 5/0 Polypropylene suspended sutures (Aragò, Barcelona, Spain) around the healing abutments (Fig 4). Amoxicillin 500 mg every 8 hours for 7 days, Ibuprofen 600 mgx3 for 3 days, Chlorhexidine 0.20% rinses morning and evening for 14 days were prescribed as postoperative medication.

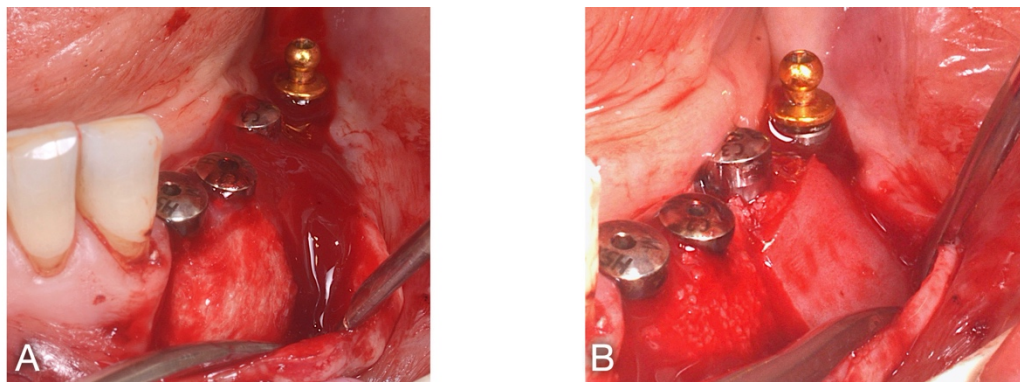


Fig 3 A: Collagen membrane with FS above bone graft on site 33-34. B: Fixed cortical lamina with FS above bone graft on site 36. A ball attachment was placed on the temporary implant in order to stabilize the partial denture

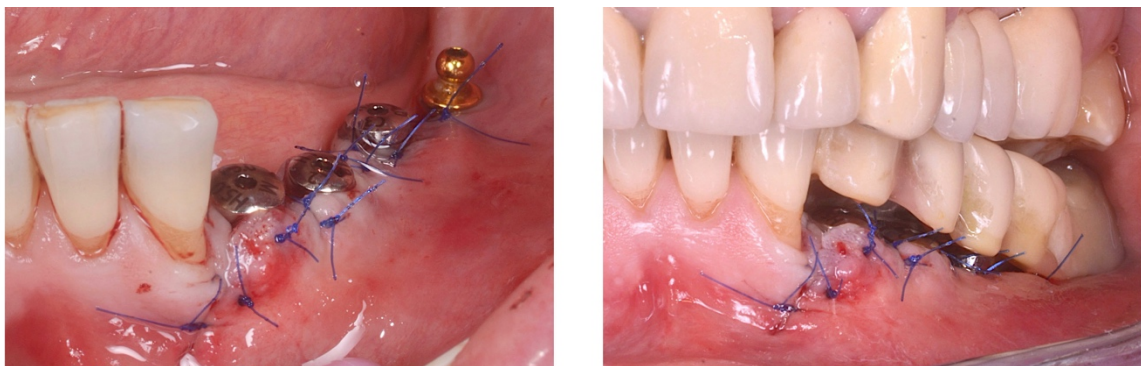


Fig 4: Suspended sutures around healing abutments. The removable prosthesis does not touch the area.

RESULTS

Sutures were removed after 2 weeks, healing was uneventful. The healing allowed good adaptation of the flaps to the abutments protecting the augmented area (Fig 5). Six months after surgery, the clinical aspect of all five cases showed an excellent volume with convexity and good consistency (Fig 6). At time of restoration healing abutments were removed and impressions taken with a pick-up technique. Final restorations were delivered by mean of zirconia crowns.

Two patients received screwed individual restorations while three patients received screwed bridges (Fig 7). Measurements taken off the CBCT after the final crowns were delivered (Planmeca Viso G7, Helsinki, Finland) showed a horizontal gain of 4.17 mm in average (Tab 1). It is showed the radiologic outcome of implant 2 (Fig 8-9-10).

The follow-up of these cases averages from 1 to 3 years and demonstrated clinically the maintenance of vestibular augmentation and an overall stability in the medium term. Intraoral X-rays (Digora Optime, Soredex, Tuusula, Finland) showed no marginal bone loss following prosthetic loading (Fig 11-12).



Fig 5: Suture removal at two weeks. Primary intention healing.

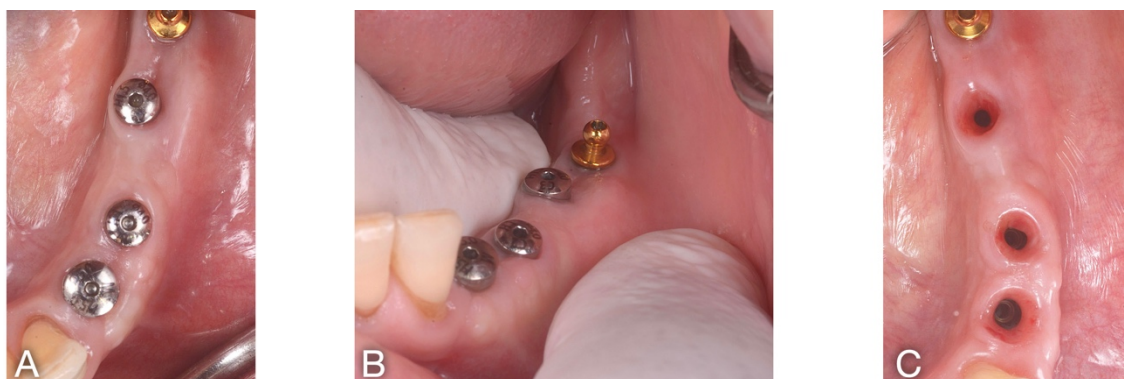


Fig 6: After 6 months. A: Soft-tissue stability. B: Volume and consistency of augmented area C: Soft tissue maturation at abutment removal

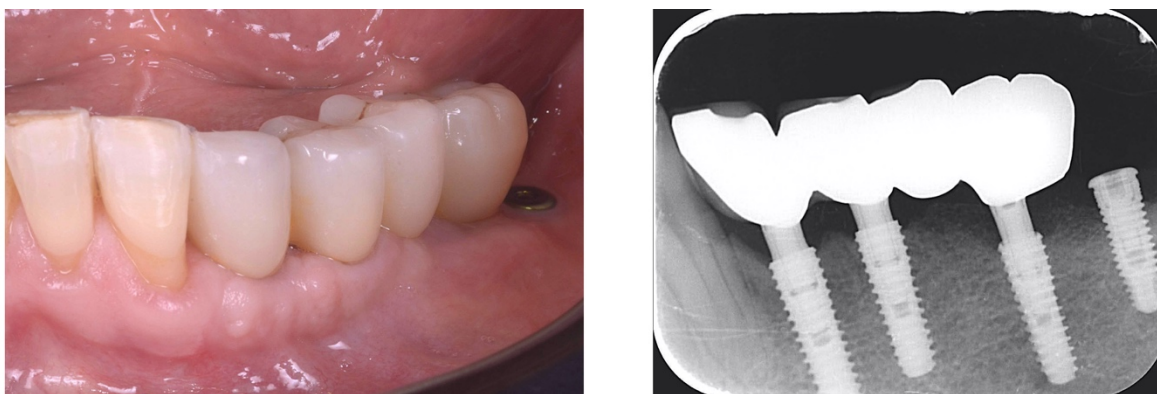


Fig 7: Final restoration. Intraoral X-ray

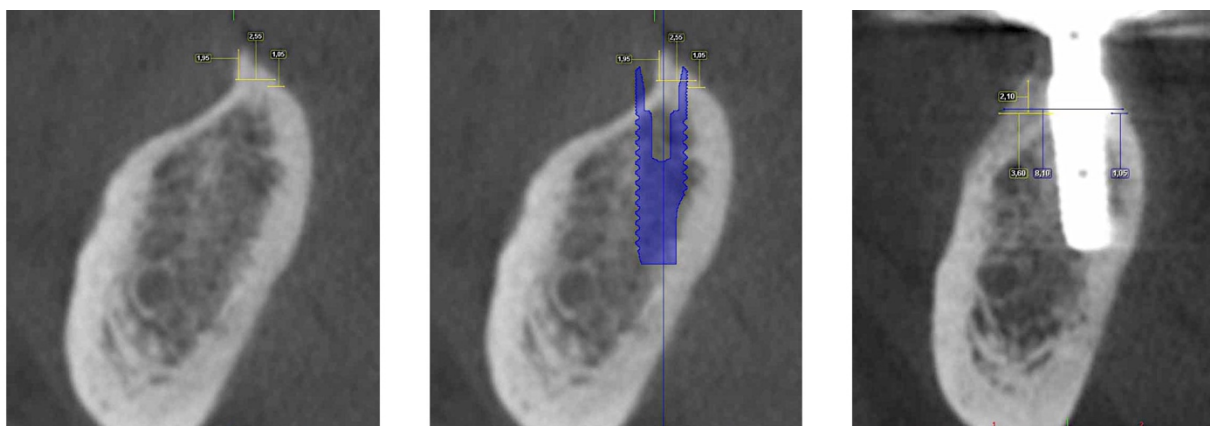


Fig 8: Cross-section CBCT. At baseline the measurements have been taken 2 mm below the crest. After 6 months 2 mm below the implant platform.

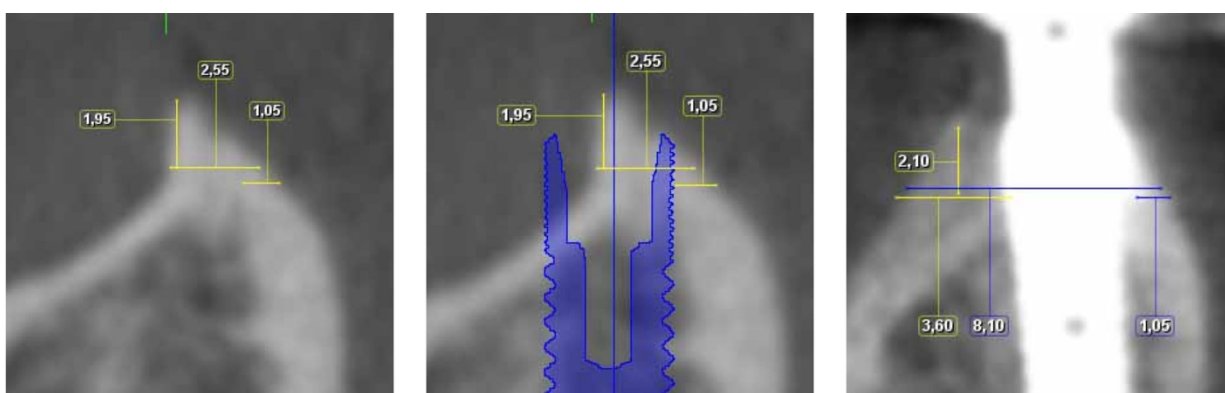


Fig 9: The outcome of implant 2 (Tab.1)

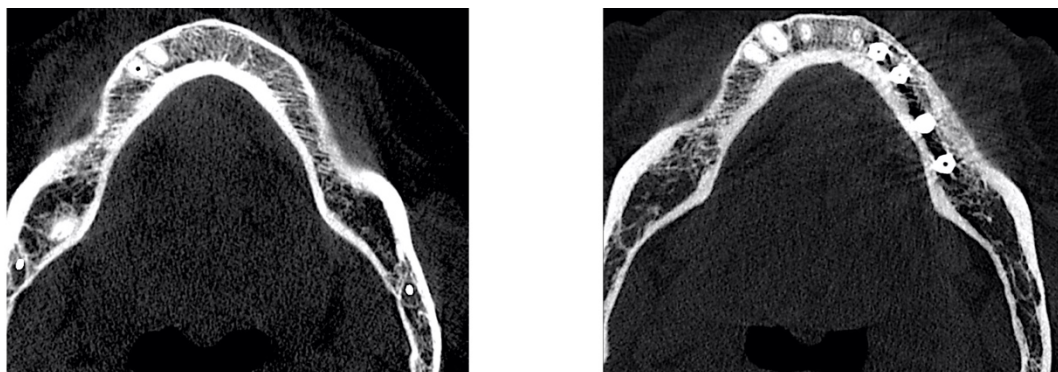


Fig 10: Axial CBCT before and after six months.



Fig 11: Control after 3 years. A: Same shape of the cortical lamina at surgery and at check. B: Intraoral X-ray.



Fig 12: Before and after 3 years.

Tab 1 Ridge width measurements 2 mm below the crest at baseline and 2 mm below implant platform after 6 months. Implants diameter 3.5 mm. Measurement resolution 0.15 mm.

One-Time Cortical Lamina	Ridge width at baseline (mm)	Ridge width after 6 months (mm)	Horizontal gain (mm)	Buccal ridge width after 6 months (mm)
Implant 1	5.55	8.70	3.15	2.15
Implant 2	2.55	8.10	5.55	3.60
Implant 3	3.20	7.80	4.60	3.30
Implant 4	2.75	8.05	5.30	3.15
Implant 5	2.90	8.35	5.45	3.05
Implant 6	4.95	7.45	2.50	2.55
Implant 7	4.80	7.50	2.70	2.45
Mean	3.81	7.99	4.17	2.89

DISCUSSION

This case series introduces a novel technique for horizontal ridge augmentation: The One-Time Cortical Lamina. It is a minimally invasive approach derived from F.I.R.S.T technique.¹⁶ In this case the procedure uses one only surgical procedure. This technique provides clinical and radiographic results, but it is not possible to provide histological data because it is a one-step procedure.

Many different surgical procedures for horizontal bone augmentation described in the literature present advantages and disadvantages. Therefore, priority should be given to those procedures or materials that are easy to handle, less invasive and involve minimal risks of complications. The cortical lamina, made of collagenated porcine bone, acts as a non-resorbable barrier when is not exposed. Its robust macrostructure does not make it collapse. It has however a canalicular ultrastructure that favors the exchange of fluids, blood cells,

mesenchymal cells and growth factors. The cortical lamina must conventionally should be stabilized using pins or screws. At second surgery, even after one year, it is always present integrated to the new bone or attached to the inner flap. This means that it has fulfilled its function of barrier stabilizing the graft. The F.I.R.S.T. strongly increases the density and the stability of the lamina-graft complex because the FS glues the 100% of cortical lamina to the graft and to the recipient site, like a wallpaper. The thrombin dilution 1:10 of FS is mandatory to avoid the immediate polymerization of FS which would get fibrous encapsulation of the graft without integration in the defect area.¹⁷ The easiness and quickness of FS is surely an improvement when compared to the use of multiple pins, necessary with other techniques, to stabilize the membrane.¹⁸ In addition, the pins should be removed with a second surgery. The immobilization of the bone graft during the early phase of healing is one of most important key factors for GBR success. The One-Time Cortical Lamina achieves all benefits and same results of the F.I.R.S.T. through an easier and minimally invasive procedure. Conceived for ASA2 patients to avoid the surgical re-entry, it can apply also on ASA1 patients. A limitation of classical techniques is the need for a second surgery to remove barrier and pins. This may injure the regenerated tissue, since it is evident that flap elevation results in a certain amount of crestal resorption of the alveolar bone.¹⁹ The suggested anatomic scenario suggests for a good amount of keratinized tissue, sufficient alveolar ridge width for placement of implants, thickness of vestibular bone at CBCT planning less than 1 mm with risk of threads exposure. The advantages of the One-Time Cortical Lamina are the displacement of keratinized tissue from lingual to buccal aspect for several millimeters, avoiding flap passivation and stretching, consequent improved blood supply, primary closure tension-free around healing abutment, no risk of wound dehiscence. The better vascularization improves the soft-tissue healing around healing abutments. The soft-tissue closure around healing abutments is adequate, as in two surgical steps techniques, to protect the bone regeneration.

CONCLUSION

This case series demonstrated the benefits of One-Time Cortical Lamina and same regenerative results of the F.I.R.S.T. through an easier and minimally invasive surgery with one only surgical step. Proposed initially to ASA2 patients to avoid the surgical re-entry, given the positive results achieved, his application has become useful also for ASA1 patients, as long as it is applied in the correct clinical situations. However further trials with more patients and sites will be necessary to confirm the excellent results achieved in this small sample.

ACKNOWLEDGMENT

The authors reported no conflicts of interest related to this study.

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