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**Inverted Gingival
Pouch Grafting Technique**

Gingival Revitalization by Inverted Gingival Pouch (IGP) Technique

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Abstract

Introduction: The reconstruction of bone and soft tissue in implant therapy for periodontally compromised patients is challenging. Based on our previous findings of periodontal surgery, a 10-year follow-up multicenter case series study was carried out in the United States, China and Taiwan. In the current article, we introduce a novel periodontal surgical procedure for Gingival Revitalization using the Inverted Gingival Pouch (IGP) Technique.

Material and Methods: In this case series, 3 patients treated with the surgical protocols of IGP technique are described and evaluated. Discussion: Primary stability of the dental implant and soft tissue primary closure were crucial to achieve the IGP technique. We believe that this report is the first dental literature in which nor-

mally discarded diseased epithelialized granulomatous tissue is utilized for the purpose of primary closure. The application of epithelialized granulomatous tissue was acceptable based on the biological process of wound healing. To better illustrate the indications of IGP technique, we established a classification of tooth vertical mobility, Class II and III were potential candidates for IGP technique. The necessity of barrier membrane in Guided Bone Regeneration in IGP technique remained is to be further explored.

Conclusion: The Inverted Gingival Pouch Technique might be potentially useful in achieving the goals of periodontal infection control, soft tissue regeneration, including increased width and thickness of keratinized tissue, bone augmentation, improved aesthetics, clinical safety, and efficiency.

KEY WORDS: Gingival Revitalization, vertical tooth mobility, Leonchen classification for vertical tooth mobility, Vertical Mobility Index (VMI)

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INTRODUCTION

In 1988, Miller described Periodontal Plastic Surgery to correct or eliminate anatomic, developmental or traumatic deformities in morphology, position and/or amount of gingiva.¹ In the 1960s to 1980s, a good amount of keratinized tissue was considered to be crucial for periodontal health. At that time, the most widely used mucogingival surgery technique was the free gingival graft.² This technique consisted of a split-thickness approach to withdraw the tissue from an edentulous ridge or from the palatal mucosa. It is carried out latter that despite the width of keratinized tissue, plaque control is prior in maintaining the attachment level. The therapy of free gingival graft was fail to treat gingival recession, the displacement of the gingival margin apical to the cemento-enamel junction, as the technique to cover denuded roots turned out to be unsatisfactory and very unpredictable.³ Another technique known as the pedicle flaps is an alternative technique that has gained popularity. It essentially was a variation of a laterally positioned flap, introduced by Grupe & Warren,⁴ and coronally advanced flap, described by Norberg in 1950's.⁵ Modifications were made by Bernimoulin and Miller in 1980's.⁶ Plenty of new surgical techniques have been proposed over the past 20 years; however, they have often been modifications of these two pedicle flap procedures.^{7,8} The achievement of ideal clinical outcomes requires high standards of clinical protocols, including flap design and incision techniques, flap elevation, root conditioning, flap mobility and flap stability and suturing.^{5,9}

Gingival recession in many periodontally compromised patients often coincides with a history of Endodontic treatment, tooth mobility, alveolar bone loss and local soft tissue infection. It

is very challenging to achieve implant survival and final aesthetics in the absence of both hard tissue and soft tissue in cases of implant therapy.¹⁰ For these patients, laterally positioned and coronally advanced flap techniques may not be attractive since the need for multiple surgeries of tooth extraction, bone augmentation, soft tissue regeneration and implant placement may be time consuming and costly. Additionally, the clinical outcomes remain controversial.¹¹

Thus, it is of great significance to explore new techniques to deal with bone loss and gingival recession for patients with compromised periodontal conditions and severe local infections, especially in implant therapy. Previously, according to the treatment results of both single and multiple teeth, our group successfully proved that the application of Enamel Matrix Derivatives (EMD) would significantly promote the clinical efficiency of root coverage.¹²⁻¹⁴ Later, with the use of EMD, we established an original technique of "three-point-translation" for root coverage.¹⁵ In a follow-up of 4 years, the clinical outcomes were promising in achieving the goals of periodontal tissue regeneration, root coverage, increase of width and thickness of keratinized tissue, clinical efficiency, and aesthetics.¹⁵ In light of this well-established technique, we came up with a new surgical to solve the problem and carried out a 10-year follow up multi-center case study in the US, China and Taiwan.

The intention of this study is to introduce a novel periodontal surgical technique, Inverted Gingival Pouch Technique, to implant therapy for patients with gingival recession, tooth mobility, alveolar bone loss and local soft tissue infection. The treatment plan includes: tooth extraction and debridement, immediate implant

Figure 1: Step by step illustration of Inverted Gingival Pouch technique (IGP).

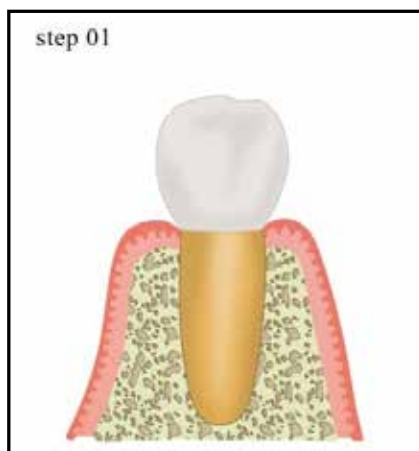


Figure 1a: Normal tooth structure, soft tissue and supporting bone.

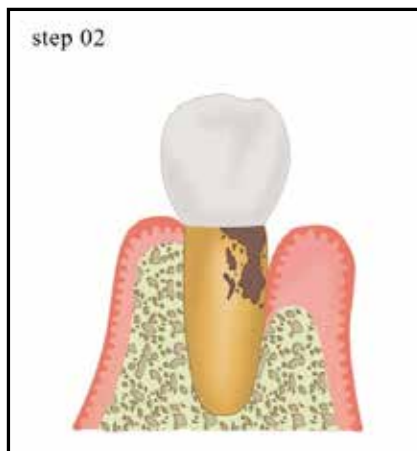


Figure 1b: Partial attachment loss and initial bone resorption.



Figure 1c: Complete attachment loss and bone resorption.

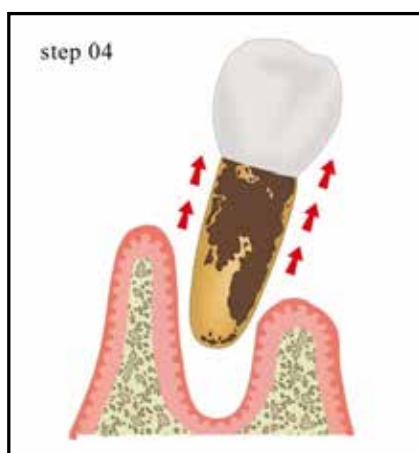


Figure 1d: Contour of soft and hard tissue after tooth extraction, the granulomatous tissue on the bottom of socket was intact.

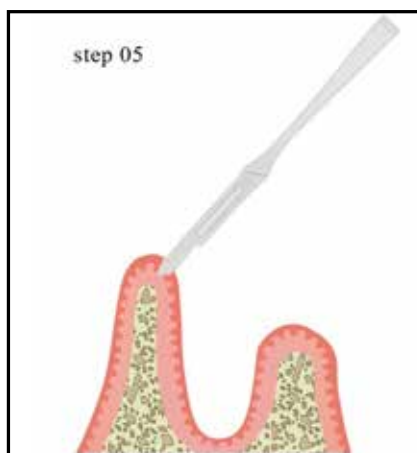


Figure 1e: Incision on the highest bony wall of the alveolar ridge.

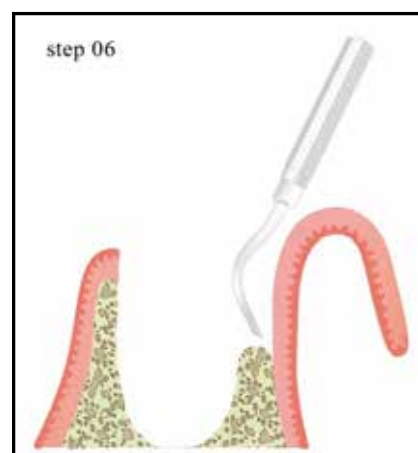


Figure 1f: Release a full thickness flap from one side of the crest; carefully elevate the granulomatous tissue as the flap across the bottom of socket to the other side of the crest.

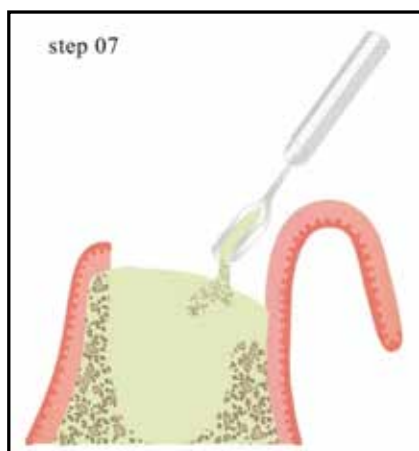


Figure 1g: To ensure complete removal of granulomatous tissue, it is necessary to sound the bone after the curettage then bone grafting materials of your choice can be filled.

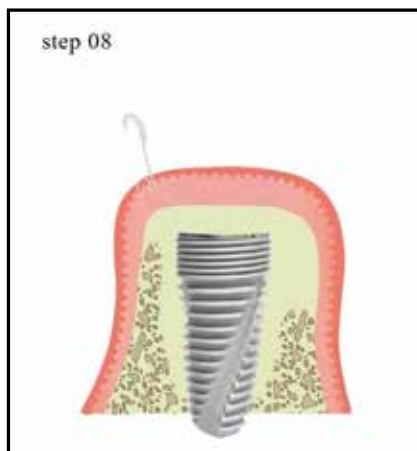


Figure 1h: Immediate implant with primary closure.

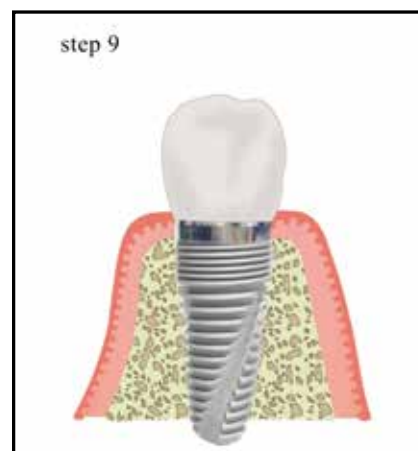


Figure 1i: Restoration after healing period.



Figure 2: Probing depth of implant #18 was more than 10mm, suggesting a complete attachment loss.



Figure 3: Clinical assessment of implant #18: vertically mobility more than 2mm; abscess present but no bleeding upon probing; no temperature sensitivity; suggest the failed implant is VMI class III vertical mobility.



Figure 4: Inverted Gingival Pouch technique: extraction of implant #18 scalpel blade 15c incision over the buccal bony wall of the extracted socket.

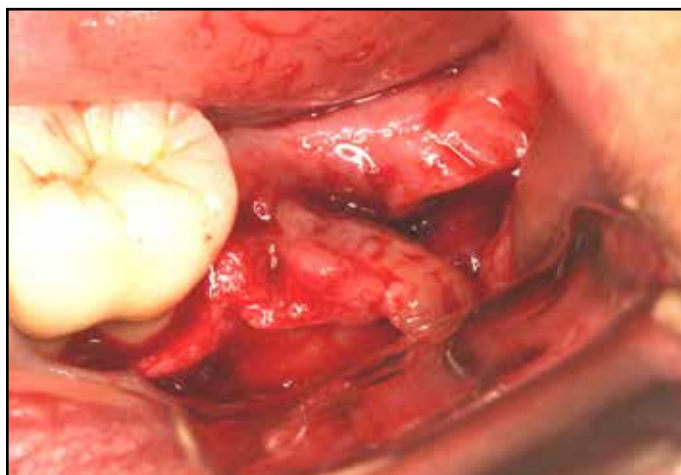


Figure 5: Inverted Gingival Pouch technique: full thickness flap, leaving the granulomatous tissue and its epithelial layer intact with the lingual flap.

placement, Guided Bone Regeneration and Inverted Gingival Pouch technique for soft tissue management. Apply the soft tissue from the infected socket both as a barrier membrane of GBR and soft tissue graft for soft tissue management, all these procedures can be well performed simultaneously in only one surgery.

MATERIALS AND METHODS

A typical surgical protocol of the Inverted Gingival Pouch technique involves the following steps: extraction of the hopeless tooth due to severe bone resorption and attachment loss; thorough debridement in the socket; an incision on the crest of alveolar ridge (preferably



Figure 6: Inverted Gingival Pouch technique: using periosteal elevator, carefully elevate the granulomatous tissue as the full thickness flap; curettage the socket and sound the exposed bone surface.

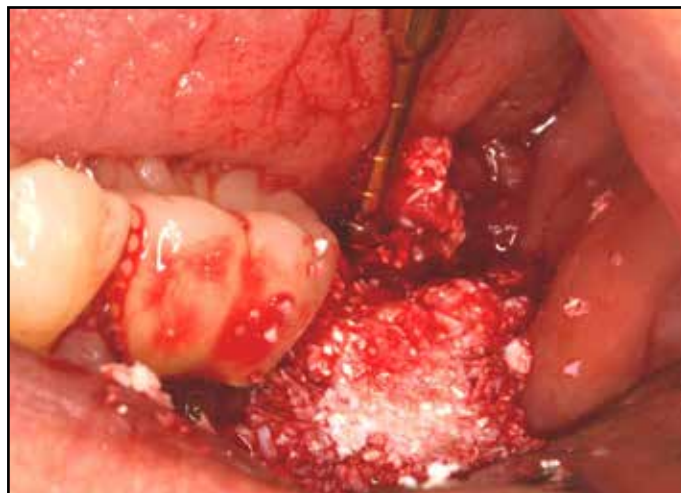


Figure 7: Inverted Gingival Pouch technique: fill the exposed socket with bone graft particulates.



Figure 8: Inverted Gingival Pouch technique: using the intact granulomatous tissue as a cap to achieve the complete primary closure, no additional flap release is needed.



Figure 9: Occlusal view of the tissue primary closure immediately after the surgery. There is no need to do any more buccal flap to release and gain more passive closure.

on the highest bone wall); release a full thickness flap from the incision on one side of the crest, across the bottom of the socket, to the other side of the crest; drilling and preparing for implant placement; fill the socket with bone

substitutes under the principles of Guided Bone Regeneration; apply the elevated flap as a barrier membrane and suturing (Fig. 1).



Figure 10: Radiographic view of complete failure of implant #18 with lucency all around before surgery.



Figure 11: Radiographic view of immediate implant #18 after Inverted Gingival Pouch technique.



Figure 12: Pretreatment radiographic view of surgery site on tooth #'s 28 and 29 with severe periodontal lesion and bone resorption, no bone contacting to the teeth, teeth were floating over the granulomatous tissue.



Figure 13: Tooth #'s 28, 29: vertically mobility more than 2 mm; abscess but no bleeding upon probing; no temperature sensitivity; teeth were non-vital, suggest the implant is VMI Class II vertical mobility. The clinical assessment indicate that the case is appropriate to Inverted Gingival Pouch technique: extraction of tooth #'s 28 and 29, leaving granulomatous tissue intact.

Case 1

A 47-year-old, Caucasian female, treated at Dental Implant Institute, Las Vegas, NV USA, presented with a failed #18 implant that had severe chronic inflammation, no symptoms,

but with vertical mobility index (VMI) class III (see Table 1). According to the patient, this implant was placed in 1997 and eight years after the restoration the patient noticed the crown was loose. Since the implant and loose

Table 1: The Leonchen Classification of Vertical Mobility for Inverted Gingival Pouch Technique

Classification	Vertical Mobility	X-ray Lucency	Clinical Symptoms	Application of IGP
I	< 1mm	Circumferential root lucency extended all the way down except the apical root tip area.	Has horizontal mobility class III vertically push the tooth less than 1mm. Abscess mixed with bleeding when probe. Sensitive to temperature. Tooth is mostly vital.	Limited
II	≥ 1mm	Less than 3mm lucency all around the entire root.	Vertically push the tooth 1-2mm. Abscess mixed with bleeding when probe. No Sensitivity to temperature. Tooth is mostly Non-vital.	Limited to Yes
III	≥ 2mm	More than 3mm lucency all around the entire root.	Vertically push the tooth more than 2mm. Abscess but no bleeding when probe No temperature sensitivity. Tooth is non-vital.	Yes



Figure 14: Inverted Gingival Pouch technique: scalpel blade 15#c incision over lingual socket bony wall at the site of tooth No.28 and 29; using periosteal elevator carefully elevate the granulosomatous tissue as the flap; curettage and sound the exposed bone surface; implant placement. Bone graft material augmentation immediate after implant placement.



Figure 15: Inverted Gingival Pouch technique: primary closure using the intact buccal flap with granulated tissue as a cap to close up the socket, no further releasing flap needed.



Figure 16: Five weeks after immediate implant surgery, showing excellent revitalized keratinized gingiva with no inflammation tissue.



Figure 17: (right) Buccal view of tooth #22 before surgery, showing severe local inflammation, bone loss, no keratinized gingiva and more than 8mm root exposure. Vertically mobility more than 1 mm less than 2 mm; abscess but no bleeding upon probing; no temperature sensitivity; tooth was non-vital, suggest the tooth is VMI Class II vertical mobility.



Figure 18: Buccal view of tooth #22 two weeks after the Inverted Gingival Pouch surgery, showing the recovery of vertical height of soft tissue, and some characteristics of keratinized gingiva.

crown were asymptomatic, the patient was in no particular rush for a dental evaluation until now.

Case 2

A 56-year-old, Asian male, treated at the Shanghai private practice, presented with severe chronic periodontal condition on tooth #28 and #29. Tooth #30 was missing. Periodontal evaluation revealed great attach-



Figure 19: Buccal view of tooth #22 three months later, showing gingival revitalization, fully recovered keratinized tissue.

ment loss, probing revealed chronic abscess mixed with bleeding. Radiographic examination showed an extensive area of periodontal lesion and bone loss. There was no bone tissue surrounding the entire apical area. Teeth #28 and 29 were floating over granulomatous tissue on the socket, mobility of these teeth were vertical mobility index Grade II (See Table I). Treatment procedures are presented in Figures 12-16.

Case 3

A 74-year-old, Asian male, heavy smoker, treated at the private practice in Taiwan, presented with generalized chronic periodontitis with localized advanced periodontal lesion on tooth #22, severe circumferential bone loss, and severe buccal recession with root exposure 8mm. Tooth #22 had an active abscess, but was asymptomatic.

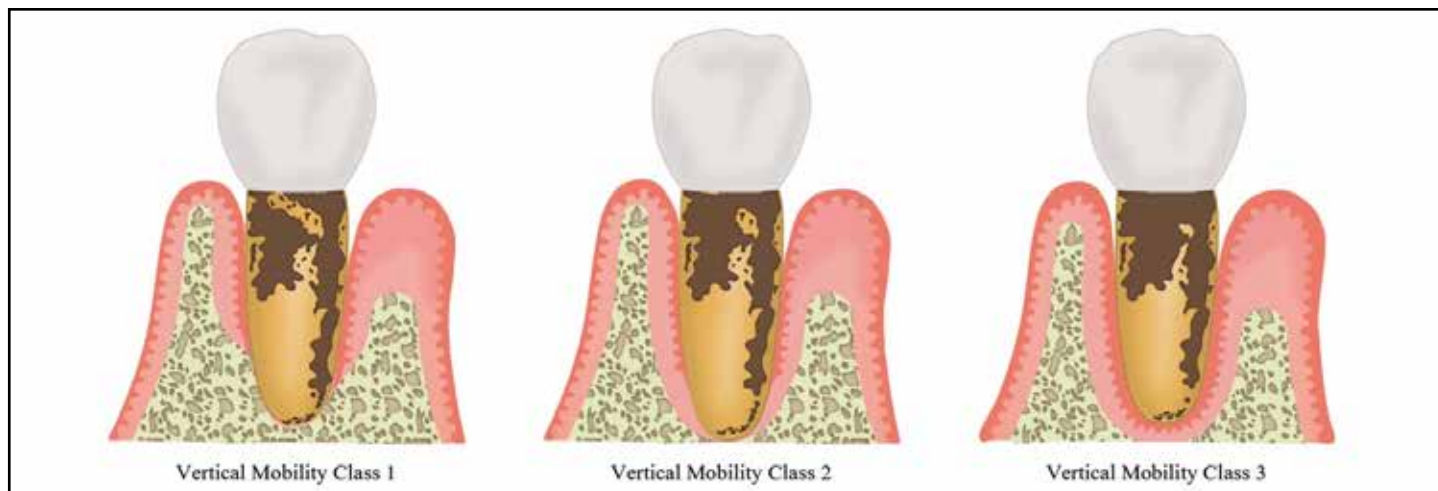


Figure 20: Leonchen classification for vertical tooth mobility (VMI).



Figure 21: Clinical examination according to Leonchen classification for vertical tooth mobility, it is obvious that the mobility is 1-2mm, abscess mixed with bleeding when probe, no sensitivity to temperature, tooth is mostly non-vital (see red arrow), thus the vertical mobility was Class II.



Figure 22: Clinical examination according to Leonchen classification for vertical tooth mobility, it is obvious that the mobility is 1-2mm, abscess mixed with bleeding when probe, no sensitivity to temperature, tooth is mostly non-vital (see red arrow), thus the vertical mobility was Class II.



Figure 23: X-ray examination, a radiolucency area of approximately 3mm, all around entire root, vertical mobility was Class II.

RESULTS

Case 1 presented as an implant failure patient with severe chronic inflammation. Figures 2-11 documented the surgical phase of therapy including implant extraction and debridement, incision design, releasing of the flap, implant placement, application of bone substitutes and securing the flap. After the surgery, the results are shown in Figures 8, 9 and 11. We obtained excellent primary closure and primary stability of implant #18 after surgery. No clinical complications, post op swelling or delayed healing were evident. In the period of follow-up, recurrence of periodontal problem, loss of bone or any other local infections were not observed. Additionally, bone height of the patient remained stable and the peri-implant tissue was in good health.

In case 2, teeth with severe chronic periodontal inflammation were floating over granulomatous tissue. Figures 12-16 document the surgical phase of therapy including implant extraction and debridement, incision design, releasing of the flap, implant placement, application of bone substitutes and securing the flap. After the implant surgery, the result of 5 weeks' recovery is demonstrated in Figure 16. We obtained a diseased granulomatous gingiva revitalized it into an excellent keratinized gingiva. We also achieved sufficient implant stability with regenerated bone on implants #28 and 29 at 5 weeks after implant surgery. No recurrence of the periodontal problem, loss of bone or any other local infections were observed in the period of follow-up. The aesthetics and function of the prosthesis was satisfactory to both clinicians and the patient. The implant stability and bone osseointegration were well achieved at the time of final prosthesis delivery.

The patient in Case 3 (Figure 17) presented with severe bone loss and buccal recession with root exposure. This heavy smoking patient was treated with the IGP (Figure 18). Three months after Inverted Gingival Pouch technique surgery, vertical height and well-being of soft tissue were achieved (Figure 19).

DISCUSSION

In Cases 1, 2 and 3, the periodontally compromised patients were in poor conditions in terms of well-being of periodontal tissue and insufficient bone volume for implant placement. The application of Inverted Gingival Pouch Technique achieved infection control, flap design, implant placement and bone augmentation simultaneously in one surgery. In all cases, the clinical outcomes

were appealing and the long-term effectiveness were achieved. These results suggested that the Inverted Gingival Pouch Technique was an effective and safe alternative technique in the implant therapy for patients suffering from periodontal diseases. Primary implant stability and primary closure are prerequisites for successful osseointegration, wound healing and tissue regeneration.¹⁶ The clinical understanding of primary implant stability is often based on the resistance of the implant during its insertion. An ideal stability may be accentuated if there is a feeling of abrupt stop at the seating of the implant.¹⁷ Thus, we strongly recommended that the torque should be at least 20 Ncm. Primary closure is recognized as an important factor for success. The flap has to be fully raised and completely closed for bone regeneration. It ensures undisturbed and uninterrupted wound healing.¹⁸ However, for periodontally compromised patients, soft tissue is frequently insufficient to achieve complete primary closure as the result of recession of periodontal tissue and thin soft tissue biotype. Particularly in patients with severe local infection on the extraction site, it is well accepted that granulomatous tissue formed in the process of infection on the socket is not only useless to raise a flap for primary closure, but also needs to be thoroughly removed after tooth extraction for debridement. Instead of discarding the granulomatous tissue, the Inverted Gingival Pouch techniques make full use of epithelialized granulation for primary closure.

Different techniques have been applied for primary closure, including soft tissue punch, connective tissue graft, barrier membrane, soft tissue replacement matrix.¹⁹ Normally we tried to rebuild the lost tissue with these methods after the removal of all the tissue underneath the extracted

socket. This time-consuming treatment required multiple surgeries after extraction. As for Inverted Gingival Pouch Technique, it can eliminate all the extra regeneration surgeries at the time of tooth extraction. We have to put special emphasis here: this is the first time in the dental world that normally discarded diseased epithelialized granulomatous tissue is utilized for the purpose of primary closure. The treatment concept of Inverted Gingival Pouch Technique brings light on implant therapy for periodontally compromised patients.

This Inverted Gingival Pouch Technique may only be used in special situations. The indications have to be fully discussed and appreciated. It is not rare to see many patients who were likely to neglect their periodontal disease so long to the point that the affected teeth came out to be hopeless to maintain and there was no longer any bone contacting the teeth roots. These hopeless teeth are potential candidates for Inverted Gingival Pouch Technique. To better describe the indication, we establish a novel classification of tooth mobility on vertical dimension (Figure 20). Given this novel classification, the most crucial criteria of the indication of Inverted Gingival Pouch Technique is the integrity of the granulomatous tissue in the socket. In Class 1 patients, no granulomatous tissue completely covered the socket after tooth extraction and bone sounding, the insufficiency of soft tissue fail to raise complete flap for primary closure. Thus, Inverted Gingival Pouch Technique is limited. Meanwhile, in class 2 and 3 patients, the priority thing to do after tooth extraction is to exam and sound the tissue. Our interest lay in the patients with granulomatous tissue and keratinizes epithelium. The bottom of the affected socket was covered by a layer of granulomatous tissue in these patients. In

the progress of periodontitis or other local infections, this granulomatous tissue would develop to an epithelial lining surrounding the granulomatous tissue around the root tip. If the thickness of these tissues is all more than 2 mm intact, we suggest performing Inverted Gingival Pouch technique. Additionally, another factor that should be taken into consideration is bleeding after. If the tooth extraction causes no bleeding, which means the epithelium has grown over and completely cover the bottom of the socket, Inverted Gingival Pouch technique is preferred. Only in these situations can you utilized the Inverted Gingival Pouch Technique applying invagination pouching: instead of discarding the epithelialized granulomatous tissue, it is better to release a full thickness flap by peeling the tissue away from the bony layer.

Wound healing in periodontal tissue was a complex process involving inflammation, granulomatous tissue formation, neo-vascularization, re-epithelization and matrix remodeling.²⁰ In a typical process, a clot in the wounded tissues would initially be formed. Then the invasion of inflammatory cells, fibroblasts and endothelial cells to the clot would generate a granulomatous tissue, while the migration of the epithelial cells result in a cover of the denuded surfaces. Finally, in contraction or scarring, the healing tissue matrix became mature.²¹ Granulomatous tissue, as a complex reservoir of cytokines and growth factors, consisted of new capillaries, macrophages, fibroblasts and some loose connective tissue.^{21,22} The formation and maturation of granulomatous tissue is the result of a series of cellular and molecular mechanisms. The ingrowth of macrophages, fibroblasts and new blood vessels to the wound space in a

coordinated manner resulted in the formation of granulomatous tissue.²³ The chemo-attractive, mitogenic and other regulatory activities of the cytokines and growth factors contributed to the epithelialization of granulomatous tissue. From this biological point, the application of epithelialized granulomatous tissue in Inverted Gingival Pouch Technique is reasonable.

On one hand, making use of the epithelialized granulomatous tissue could be effective in Inverted Gingival Pouch technique. On the other hand, the epithelialized granulomatous tissue is emerged in the process of resisting local infection and wound healing. The sites selected to conduct this technique are usually affected with chronic infections, which would no doubt jeopardize bone regeneration. As a result, the Inverted Gingival Pouch technique Grafting area should be thoroughly cleaned up.

In patients with implant therapy, insufficient bone volume for implant placement was another problem as well as the well-being of the soft tissue. Inverted Gingival Pouch Technique, however, presented a novel solution to this problem. After peeling epithelialized granulomatous tissue, the released full thickness flap was able to pouch bone grafts as a barrier membrane in Guided Bone Regeneration to gain vertical bone height in area that is severely resorbed. Using collagen membrane along with the flap or not needs further research, but for now it is surgeon's preferences.

CONCLUSION

We conclude that, within the limits of this preliminary case study, this Gingival Revitalization by Inverted Gingival Pouch Technique might be potentially useful in achieving the

goals of periodontal infection control, soft tissue regeneration, including increased width and thickness of keratinized tissue, bone augmentation, improved aesthetics, clinical safety, and efficiency. Clearly, further clinical and histological studies are required before this technique can be recommended for routine use. ●

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Disclosure

All the authors have no financial interest, either directly or indirectly, in the products or information listed in the paper.

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