

The Tunnel Wall Approach and Enamel Matrix Derivative to Cover Exposed Roots and Improve Clinical Attachment Levels in Cairo Class III Defects Associated with an Intrabony Lesion in the Anterior Area: Three Cases



Julien Mourlaas, DDS¹
Benjamin Cortasse, DDS²
François Vigouroux, DDS³
Alex Dagba, DDS⁴

These case reports present a surgical technique to improve the clinical attachment level and cover the exposed root surface in Cairo Class III situations associated with a one- to two-wall combined intrabony defect in the anterior area. The tunnel wall approach combined previously described concepts and placed a CTG into a modified tunnel-type flap through a vertical releasing incision. The CTG acted both as a buccal soft tissue wall to stabilize the blood clot and as a space maintainer to coronally move the tissue. The decontaminated root surfaces were treated with enamel matrix derivative, and a bone filler material was placed from the bottom of the intrabony defect up to the cemento-enamel junction to support the proximal soft tissue architecture. Healing of the four presented sites was uneventful. Clinical measurements up to 12 months showed significant probing depth reduction, clinical attachment gain, and coverage of the buccal recession in each case. Papilla improvement was reported in three cases. Radiographic examinations confirmed intrabony defect healing and the presence of embedded bone filler material in the soft tissue above the bone crest. The tunnel wall approach seems to be a valuable option to safely enhance the clinical attachment level and cover the exposed root in Cairo Class III situations associated with a one- to two-wall combined intrabony defect in the anterior area. Int J Periodontics Restorative Dent 2023;43:95–102. doi: 10.11607/prd.6352

The surgical treatment of an isolated intrabony defect might present an esthetic challenge. Loss of the buccal and proximal bony walls might be associated with papilla flattening and apical migration of the midfacial gingival level. This disruption of the soft tissue architecture in the anterior area would then be part of the patient's esthetic complaint. Thus, the purpose of the surgical treatment should be to regenerate the whole attachment apparatus and to restore a harmonious soft tissue architecture in a single surgical time.

Few approaches have been presented to treat one- to two-wall combined defects associated with buccal root exposure. Among recent publications, the use of a coronally advance flap (CAF) has been suggested by Rasperini et al¹ to box the interproximal space buccally. In order to thicken the buccal soft tissue wall and enhance the stabilization of the blood clot, Zucchelli et al² introduced a combination of CAF and a connective tissue graft (CTG). This CTG wall technique (CT-GWT) improves the interproximal clinical attachment level and covers the surrounding exposed roots in a single surgery. However, open-flap procedures have been associated with postoperative wound opening, with rates ranging from 10% to 50% depending on the flap design.^{3–7} Such a complication is particularly

¹Private Practice, Neuilly sur Seine, France.

²Private Practice, Pernes les Fontaines, France.

³Private Practice, Cadaujac, France.

⁴Private Practice, Paris, France.

Correspondence to: Dr Julien Mourlaas, 18 Boulevard Vital Bouhot, 92200 Neuilly sur Seine, France. Email: jm5809@nyu.edu

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Table 1 Clinical Parameters Evaluated Before Surgery, at 6 Months, and at 12 Months

	Initial			6 mo			1 y					
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3			
	Tooth 21	Tooth 12	Tooth 13	Tooth 21	Tooth 12	Tooth 13	Tooth 21	Tooth 12	Tooth 13			
Buccal RD, mm	1	2	1	3	0	0	0	0	0	0	0	–
PD, mm	8	6	8	7	4	3	3	4	3	3	2	–
CAL, mm	–10	–8	–9	–8	–6	–3	–3	–4	–5	–3	–2	–
CAG, mm	–	–	–	–	+4	+5	+6	+4	+5	+5	+7	–
PH	III	III	II	III	III	II	I	I	III	II	I	–
Defect	1 to 2 walls	1 to 2 walls	1 to 2 walls	1 to 2 walls	–	–	–	–	–	–	–	–

CAG = clinical attachment gain; CAL = clinical attachment level; RD = recession depth; PD = probing depth; PH = papilla height. Tooth numbers are listed according to the FDI tooth-numbering system. Papilla height is classified according to Nordland and Tarnow parameters.¹⁵

at risk as the weakest part of the flap is the cut papilla facing the intrabony defect. Reopening the flap during the healing phase would compromise the regenerative and reconstructive results.^{8–10} To limit this hazard, Aslan et al¹¹ suggested a combination of a tunnel-type flap and a vertical releasing incision to treat an isolated intrabony defect without coverage of an adjacent root exposure. Multiple publications evaluated the entire papilla preservation technique (EPPT) with no report of wound exposure.^{11–13}

The design of the tunnel wall approach (TWA) presented herein combined the defect access from the EPPT and the ability to achieve root coverage from the modified tunnel technique.¹⁴ In addition, a CTG was used to thicken the soft tissue buccal wall based on the CT-GWT description.²

Purpose of this case reports was to describe the step-by-step surgical

process of the TWA, to report the 6-month to 1-year results, and discuss its advantages and limitations.

Materials and Methods

Three patients and a total of four sites were included in this case report. Each patients was referred to a private periodontal practice and was selected according to the following inclusion criteria: adult patients (≥ 18 years old), systematically healthy, no smoking habit, stabilized periodontium after initial therapy, and presence of an intrabony defect associated with a gingival recession in the esthetic area (anterior maxilla, canine to canine) ranging from 1 to 3 mm.

The following clinical measurements were performed before surgery and at the final follow-up (between 6 and 12 months) and are reported in Table 1: (1) recession depth, measured from the ce-

mentoenamel junction (CEJ) to the gingival margin; (2) probing depth (PD), measured from the gingival margin to the bottom of the sulcus; (3) clinical attachment level (CAL), measured from the CEJ to the bottom of the sulcus; (4) clinical attachment gain, obtained from the following formula: $CAL_{initial} - CAL_{xmonths}$; and (5) papilla height, according to the classification from Nordland and Tarnow.¹⁵

Surgical Protocol

The surgical protocol was performed as follows for all included cases.

Anesthesia

Local infiltration was performed using articaine with adrenaline (1:100,000). On the buccal side, care was taken to enter the mucosa two teeth mesial from the defect to avoid tearing the tissue next to the surgical



Fig 1 An intrasulcular incision was made 360 degrees around the teeth to be included in the tunnel flap.



Fig 2 A full-thickness vertical releasing incision was made from the midfacial aspect up to 2 mm beyond the mucogingival line.



Fig 3 Full-thickness elevation of a tunnel flap up to the mucogingival line provided limited access to the defect.



Fig 4 Papilla elevation was performed in the interproximal space without disruption.

site. Palatal infiltration was also performed.

Flap design

Intrasulcular incisions were first made using a microsurgical blade (Viper blade, MJK Instruments), 360 degrees around each tooth, and extended up to two teeth from the intrabony defect (Fig 1). This distance may vary depending on the flap mobility.

A vertical full-thickness incision was then made using a 15C blade. It was cut from the midfacial aspect of the tooth adjacent to the bony de-

fect and the vestibular recession, up to 2 mm beyond the mucogingival line (MGL) (Fig 2).

Tunnel flap elevation

The keratinized tissue was elevated, full-thickness, up to the MGL. Tunneling knives (Hu-Friedy) were inserted beneath the tissue from the releasing and intrasulcular incisions. Care was taken to avoid tearing the flap (Fig 3) and to limit the elevation of each papillae to its base. At this stage of the surgery, the flap mobility was still limited.

Flap mobilization

Two partial-thickness incisions were made to obtain sufficient tissue mobility to coronally move the flap. The first incision was made more deeply to detach the MGL. The second incision was more superficial, aimed at releasing the mucosa.

Papilla elevation

The base of each papilla was cut, partial-thickness, by inserting a microsurgical blade into the tunnel. The whole papillae were then elevated using tunneling knives. This

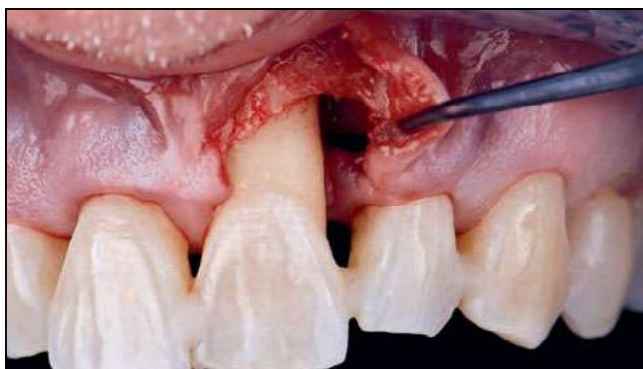


Fig 5 Granulation tissue was removed from the intrabony component of the defect, and the root surface was mechanically cleaned.



Fig 6 The deepithelialized FGG was calibrated.

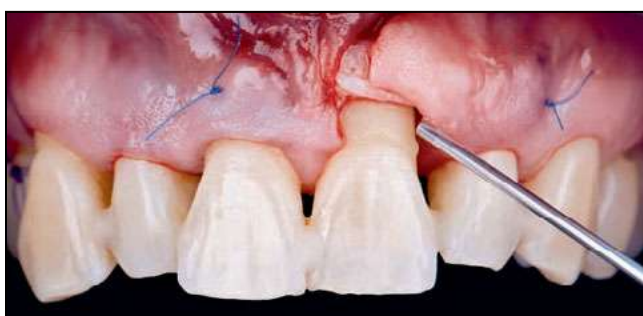


Fig 7 Enamel matrix derivative was applied.



Fig 8 The intrabony component of the defect was filled with demineralized freeze-dried bone allograft up to the CEJ.

step allowed for full rotation of the papillae with coronal flap movement (Fig 4).

Defect instrumentation

The granulation tissue from the intrabony component of the defect was eliminated with a micro-endo excavator (Hu-Friedy). Care was taken to deeply clean the bone surface of any soft tissue remnants (Fig 5).

Root surface treatment

The root surface facing the defect and exposed to the oral cavity buccally was instrumented using a curette (Hu-Friedy). An EDTA gel 24% was then applied on the surfaces for 2 minutes and rinsed with saline for 1 minute. Purpose of the EDTA

was to eliminate the smear layer and expose the collagen fibers from the root surface in order to stabilize the blood clot.¹⁶

Connective tissue graft

A free gingival graft (FGG) was taken from the superficial part of the palate and then deepithelialized (DFGG) using a 15C blade. After preparation (Fig 6), the graft dimensions were 0.8 to 1 mm thick, and the height was able to fully cover the defect buccally and compensate for the loss of the buccal wall (the graft should extend from the CEJ to 1 mm apical of the coronal edge of the remaining buccal wall). The graft length extended at least one tooth mesial and distal

from the tooth associated with the bone defect and gingival recession. The DFGG was inserted in the tunnel from the releasing incision and sutured to the keratinized tissue mesially and distally with two simple knots (6-0 Prolene, Hu-Friedy).

Regeneration procedure

An enamel matrix derivative gel (Emdogain, Straumann) was applied on the exposed root surfaces free from bleeding in order to stimulate the periodontium regeneration (Fig 7). A particulate demineralized freeze-dried bone allograft (DFDBA) was placed in the intrabony part of the defect up to the CEJ to support the soft tissue, especially in the proximal area (Fig 8).

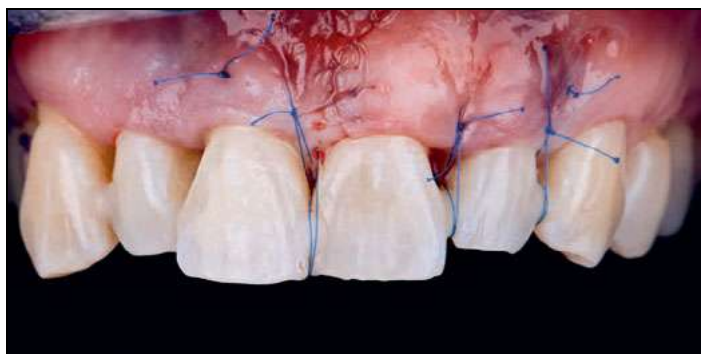


Fig 9 The flap was coronally displaced and the vertical releasing incision was sutured.



Fig 10 Case 1. Buccal recession coverage and a 3-mm probing depth were seen at the 12-month follow-up.

Sutures

The tissue was finally secured in a coronal position, with complete coverage of the DFGG, using double-cross sling sutures (6-0 Prolene). The vertical releasing incision was closed using single interrupted knots (7-0 PGA, Stoma) (Fig 9).

Results

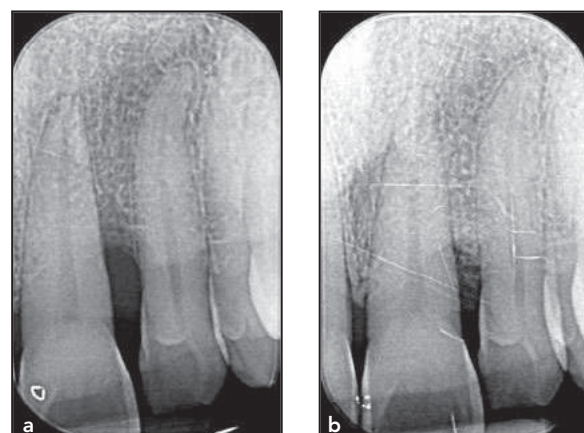
Primary healing of the vertical releasing incision, continuity of all interdental papilla, 100% wound closure, and no exposure of the CTG were reported for all patients during the first month of the early healing phase. During the follow-up, each case showed a healthy tissue free of clinical inflammation. The measured parameters are presented in Table 1.

Clinical Cases

Case 1

At the 12-month follow-up, the PD was 3 mm and buccal recession coverage was achieved (Fig 10). The radiographic examination showed bone densification corresponding

Fig 11 Case 1. (a) The initial periapical radiograph shows the intrabony component of the lesion distal to tooth 21 (FDI tooth-numbering system). (b) The radiograph at 12 months shows densification in the intrabony part of the defect and biomaterial particulate above the crestal bone, in the papilla soft tissue.



to the healed intrabony component of the defect, and embedded bone filler material was seen in the soft tissue, above the crestal bone (Fig 11).

Case 2

At the 12-month follow-up, buccal recession coverage was achieved on teeth 12 and 13 (FDI tooth-numbering system) and the distal tips of the papillae had moved coronally. The PD was 2 mm for the distal part of tooth 13 and was 3 mm for the mesial part of tooth 12 (Fig 12). Radiographic examination showed bone densification corresponding to the healed intrabony component

of the defect, and embedded bone filler material was seen above the crestal bone (Fig 13).

Case 3

At the 6-month follow-up, buccal recession coverage was partially achieved, the mesial tip of the papilla was positioned above the proximal CEJ position, and the PD was 4 mm (Fig 14). Radiographic examination showed bone densification corresponding to the ongoing healing of the intrabony component of the defect, and embedded bone filler material was seen above the crestal bone (Fig 15).



Fig 12 Case 2. (a) Initial and (b) 12-month clinical views. At 12 months, buccal recession coverage can be seen at teeth 12 and 13, as well as papillae growth.



Fig 13 Case 2. (a) Initial periapical and (b) 12-month radiographic views. At 12 months, densification was seen in the intrabony part of the defect, as well as visible biomaterial particulate above the crestal bone, below the papilla soft tissue.

Discussion

The TWA aims to provide access to the intrabony defect without disrupting the papilla and to cover the surrounding exposed root surface in a single surgery.

The CTGWT, presented by Zucchelli et al in 2014,² is the first surgical technique designed to simultaneously increase the CAL in the proximal area and to cover the gingival recession in a Miller Class IV defect. The authors used a combination of a CAF and a CTG sutured buccally in front of the missing bone walls. The purpose of the CTG was then to thicken and stabilize the flap in a coronal position. The 1-year follow-up in that study² showed a complete buccal root coverage in 100% of cases and a significant clinical attachment gain, from 2 to 7 mm. Further, each case gained one level according to Nordland and Tarnow's papilla classification.¹⁵ Besides these good results, a significant risk for wound opening during the healing phase should be highlighted. Although this parameter was not recorded for the two cases presented by Zucchelli et al² and thus could not be measured, it has



Fig 14 Case 3. (a) Initial and (b) 6-month clinical views. Partial root coverage, a 4-mm probing depth, and significant papilla growth in the interproximal space were seen at 6 months.

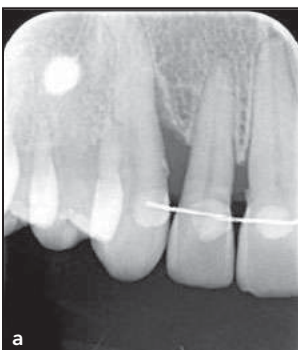


Fig 15 Case 3. (a) Initial and (b) 6-month radiographic views.

been explored for various regenerative surgical protocols. Wound opening occurred in up to 50% of cases who received classical guided tissue regeneration surgery,³ and this rate dropped to 30%^{4,5} and then 10%^{6,7} when minimally invasive flaps and specific papilla elevation techniques were used in combination. Nevertheless, surgical procedures based on a tunnel-type flap were the only ones without reported wound exposure.^{11–13,17,18}

Recently, the apically incised coronally advanced surgical technique (AICAST) was published by Calzavara et al¹⁸; like the CTGWT, the technique was designed to increase the CAL in the proximal area and to cover the adjacent gingival recession. However, in order to avoid the risk of wound opening, the AICAST combined a tunnel-type flap and a single horizontal incision positioned 10 mm apical to the midfacial aspect of the tooth. The granulation tissue was not removed from the site but detached from the defect and pushed into the proximal space, below the contact point, to support the papilla as a scaffolding material. The defect was filled with a xenograft, and a CTG was added in case of gingival recession at baseline. Despite uneventful healing, a significant PD reduction (6.05 ± 1.76 mm), and significant CAL gain (7.20 ± 2.13 mm), a nonsignificant root coverage was reported.¹⁸ One explanation might be that the tissue would only be released from the full-thickness horizontal incision line. Thus, this design achieves only limited mobility.

The TWA also features a tunnel-type flap but in association with a full-thickness elevation of the keratinized tissue and double split-flap elevations apical to the MGL, like the CTGWT. The rationale was the ability to limit the risk for wound opening while using the vertical releasing incision as an access point to perform double split-flap incisions and greatly enhance the coronal mobilization of the tunnel flap.

In 2016, Santoro et al¹⁹ modified the CTGWT by adding a bone filler as a secondary scaffolding material in cases with a Miller Class IV defect depth greater than 5 mm. The TWA used a DFDBA placed up to the CEJ of the tooth to enhance the tissue support in the proximal area. The particles located above the bone crest would remain embedded in the soft tissue, free of inflammation,²⁰ and act as an additional scaffold to support the papilla, especially in cases with a deep and large defect. Nevertheless, influence of the DFDBA should be specifically explored. Today, a combination of surgical and restorative treatment remains the more predictable papilla reconstruction approach.²

To access the intrabony defect, the TWA used a vertical releasing incision from the midfacial aspect of an adjacent tooth, extended up to 2 mm beyond the MGL, and this may jeopardize the esthetic result associated with the tunneling technique.²¹ However, a precise incision line, careful tissue manipulation to avoid tearing the flap, and an accurate adaptation of the tension-free flap margins²² may preserve the

potential for a high esthetic result. To reduce the risk of scarring at the midfacial location, a vestibular incision subperiosteal tunnel access (VISTA) approach²³ could be suggested in order to reduce the size of the vertical incision. Alternatively, access to the defect might be limited, and thus the proper cleaning of a wide and deep lesion may not be completely achievable. The TWA should maximize access to the defect compared to a VISTA approach. However, in case of a recession type 3 defect extending both buccally and lingually, a total papilla elevation may be required. In such a situation, the original CTGWT would be indicated.

Conclusions

Within the limitations of this report, the results suggest that the TWA might be a valuable option to safely treat a one- to two-wall combined intrabony defect (with loss of the buccal and proximal bony walls associated with a gingival recession) in the esthetic area in a single surgery.

Acknowledgments

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