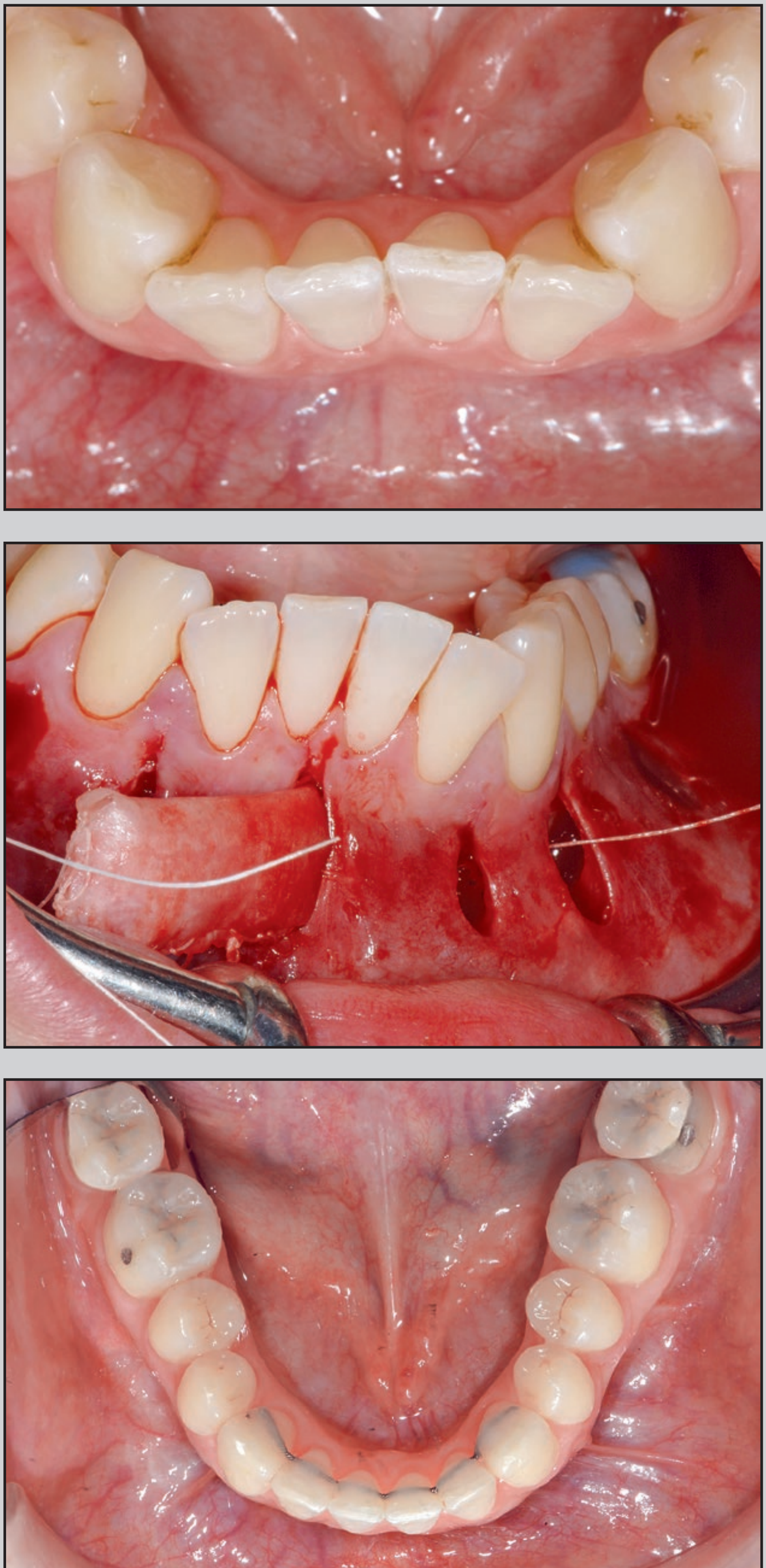
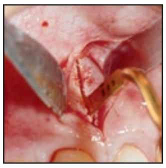


# MAPA-cision: A New Regenerative Technique for Periodontally Facilitated Orthodontic Treatment. A Case Series



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*MAPA-cision, named after those who first introduced the method, is a novel simplified regenerative technique for periodontal-orthodontic cases that can be used in all circumstances where bone thickening is required. It is an innovative, minimally invasive piezoelectric surgical procedure designed to facilitate orthodontic tooth movement while simultaneously increasing bone thickness with guided bone regeneration principles. A new regenerative device consisting of a resorbable collagen membrane with filling materials (a "bone bundle" or "small sausage") is inserted through a tunneling procedure to increase the bone envelope width by allowing the teeth to move within an enhanced periodontal support.* Int J Periodontics Restorative Dent 2021;41:23–30. doi: 10.11607/prd.5238

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Although recent orthodontic innovative appliances and techniques are more acceptable to adult patients, short treatment time has become a recurring request.[1,2] However, the nonextractive approach forces the teeth to move against the buccal cortical bone, sometimes pushing them to the limit, or even outside the bony envelope, creating fenestrations and/or dehiscences. Several methods have been proposed to accelerate orthodontic movement with minimal complication. However, a surgical approach, as corticotomy, seems to be the most effective way, minimizing complications and side effects,[3–7] ensuring greater stability through the creation of a new periodontal phenotype.[8] Among surgical techniques,[9–12] only periodontally accelerated osteogenic orthodontics (PAOO)[9] could be considered a surgical technique designed to accelerate orthodontic movement and provide bone regeneration, while the remaining techniques do not have any regenerative goals. The purpose of the present case series is to describe a new minimally invasive procedure that can facilitate orthodontic movement and predictably improve the periodontal phenotype, allowing the desired tooth movement inside the bony envelope, by applying the guided bone regeneration (GBR) biologic principles.

**Fig 1** *Bone bundle seen from both the perforated surface "bone side"* (left) *and the intact surface "connective side"* (right).

## Materials and Methods

Seventeen healthy adult patients (4 men and 13 women; age range: 26 to 52 years) who required orthodontic treatment presented to a private practice with different types of malocclusion. All patients were nonsmokers and were enrolled for orthodontic treatment and periodontal surgery in accordance with accepted dental practice guidelines, including informed consent.

The majority of patients presented with a thin periodontal phenotype with localized single or multiple gingival recessions, crowding, and different types of occlusal discrepancies.

### *Orthodontic Protocol: Phase 1*

Initial records, such as intraoral and facial images, study cast models, lateral cephalometric and full-mouth periapical radiographs, and CBCT scans, are collected before any treatment. A lateral cephalometric radiograph is processed from the CBCT scan. All study data are analyzed and assessed. Computerized visual treatment objective and soft tissue analysis are used as complementary diagnostic tools to select an appropriate treatment plan. One week before surgery, a bidimensional fixed orthodontic appliance[13,14] (Edgewise, Dentsply Sirona; 0.022 × 0.028–in slot dimensions on lateral and posterior teeth, and 0.018 × 0.025–in dimensions on anterior teeth) with a light superelastic wire (0.016-in; Neo Sentalloy, Dentsply Sirona) is applied with the exception of cases where a guided piezosurgical stent is used.[15] Any skeletal anchorage that could be necessary for orthodontic treatment is inserted at this time, except in cases where it could interfere with the surgical procedure.

### *Periodontal Surgical Phase*

Periodontal biometric parameters are recorded. All surgical procedures were performed by removing the archwire. A minimally invasive regenerative technique is implemented with a tunnel approach. On the buccal side, full-thickness vertical incisions were made through the keratinized tissue and alveolar mucosa, at strategic points at every one or two teeth. A blunt-tip dissector is used to reinforce the previous incisions. The periosteum is then elevated by a small bone chisel (CTG-O, Hu-Friedy) to access the underlying cortical bone, visualize the root prominences, and avoid damage. Vertical corticotomies are performed parallel to the adjacent root structures by means of thin piezoelectric terminals (eg, 0.35 mm) to penetrate the cortical bone and gain access to the medullary bone. The soft tissue is elevated and tunneled using the CTG-O and a Prichard elevator. The adjacent vertical incisions are then connected to insert the regenerative "bone bundle," composed of mineralized allograft and collagen membrane. Half of a resorbable membrane is perforated with a rubber dam plier, rolled, and sutured with resorbable material to form the bundle. The "perforated" surface is considered the "bone side," while the "intact" one is the "connective side" (Fig 1). After correct placement of the bone bundle, with the perforated surface in direct contact with the cortical bone, the vertical soft tissue incisions are sutured (using a horizontal, internal "U" mattress suture) to facilitate an adequate primary-intention healing process.

*Orthodontic Protocol: Phase 2*

Immediately after surgery, a superelastic nickel-titanium (NiTi) wire is inserted (0.016 × 0.022–in, Neo Sentalloy). Any unapplied skeletal anchorage that previously could have interfered with the previous surgical procedure is applied at this time.

In cases where the guided corticotomy technique with surgical stent was implemented, brackets were applied immediately after using an indirect bonding technique.

*Orthodontic and Periodontal Follow-up Phases*

Analgesic, anti-inflammatory medications and antibiotic therapy are prescribed at the clinician's discretion. Follow-up control visits at 7 and 15 postoperative days are planned, with suture removal at day 15. Orthodontic monitoring is done every 2 weeks to activate ligatures and the elastic chain and to eventually change archwires. Auxillary orthodontic devices may be used to facilitate intrusion, expansion, and torque control. When necessary, the NiTi archwires are replaced, as soon as possible, with stainless steel wires to achieve a better root control.

## Case 1

A 32-year-old female patient complained of crowded teeth and an unpleasant smile with several mucogingival recessions. A dental and skeletal Class II malocclusion with crowding of the maxillary and mandibular anterior teeth and tapered shape of the maxillary arch were present (Figs 2a to 2c). The profile was convex, with a short mandible and thin upper-lip width. The orthodontic treatment plan intended to *(1)* correct the Class II malocclusion without extraction; *(2)* expand the mandibular arch, decrease the overjet, and provide a better support for the lower lip; and *(3)* distalize the maxillary molars, premolars, and canines with arch expansion. Reconstructive mucogingival procedures were planned before starting any orthodontic movement. The periodontal objectives included covering multiple recessions and thickening the soft tissue of both arches. In a second stage, limited to the maxilla, the buccal bone thickness was increased using the bone bundle to allow tooth movement within the bony envelope. Simultaneous treatment with a one-stage bilaminar approach, characterized by a multipapillary flap associated with a connective tissue graft, was planned to increase the keratinized tissue and obtain almost complete root coverage.

In the mandible, the very shallow fornix depth was increased with free gingival autograft. Furthermore, at canine and premolar sites, the same bilaminar technique used in the maxillary arch was implemented bilaterally. After a 4-month healing period, having achieved almost complete root coverage with a marked increase in keratinized tissue, orthodontic treatment was initiated.

In the maxillary anterior sextant, a MAPA-cision technique (named after Drs Maino and Parma-Benfenati, who first introduced it) was performed to increase bone volume and facilitate orthodontic movement. In the lateral segments, a Piezosurgery approach was provided to speed up tooth movement (Fig 2d). Using the tunnel technique, two bone bundles were inserted into the anterior and lateral sextants from tooth 11 to 13 and from tooth 21 to 25 (FDI system) to avoid bony dehiscences and fenestrations (Fig 2e). Bidimensional brackets were bonded simultaneously in both arches,[13,14] and superelastic 0.016-in NiTi wire was applied 7 days before MAPA-cision. To ensure success, three mini screws (Spider Self-Ligating screw, HDC) were applied in the palate with a guided insertion technique[16,17] and coupled with a prefabricated plate (Spider Power Plate, HDC), to which elastic chains are applied to the molars, premolars, and canines to distalize them. Immediately after periodontal surgery, a 0.016 × 0.022–in stainless steel archwire was applied to the maxilla to improve the control of tooth movement. After 13 months, the orthodontic treatment was completed, and the Class II malocclusion and tooth alignment of both arches were corrected (Figs 2f to 2h).

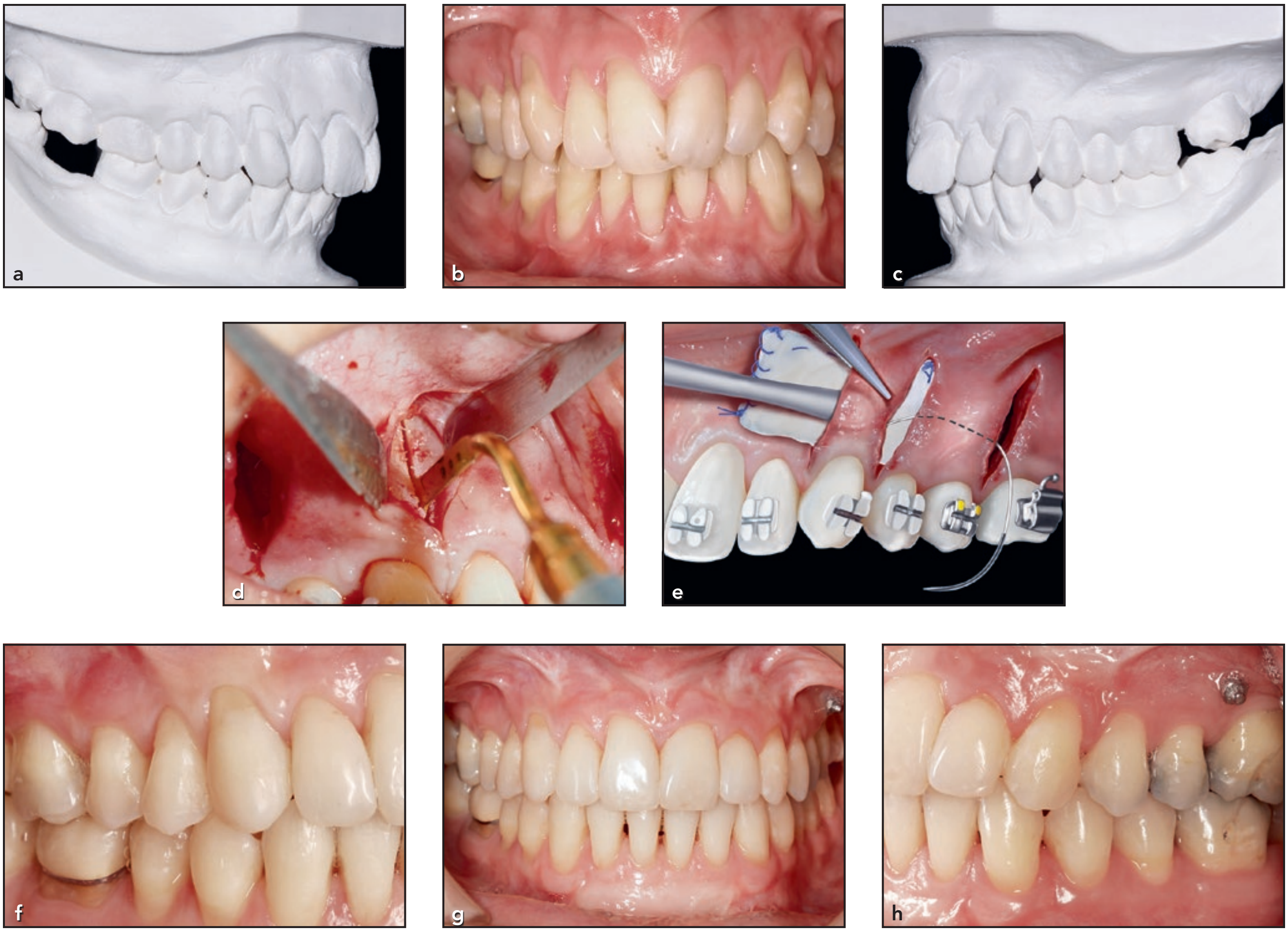

**Fig 2** *Case 1.* (a) *Right lateral cast,* (b) *buccal clinical, and* (c) *left lateral cast views of the initial situation.* (d) *A vertical corticotomy was performed with a very thin piezoelectric device.* (e) *Illustration of a bone bundle inserted into the tunneled site.* (f) *Right lateral,* (g) *buccal, and* (h) *left lateral views at the end of treatment.*

## Case 2

A 28-year-old woman requested to have her smile improved. A Class II malocclusion, bimaxillary crowding, and multiple recessions (mainly in the maxilla; thin phenotype was present) were detected (Figs 3a to 3c). The multidisciplinary treatment plan involved orthodontic treatment combined with reconstructive periodontal techniques. In the mandible, due to the orthodontic expansion treatment approach, it was decided to combine a MAPA-cision from teeth 34 to 44 with the aim of expanding the bone envelope to allow mandibular anterior teeth to align, avoiding bone dehiscences and fenestrations (Figs 3d and 3e). In the maxillary treatment plan, tooth 24 was extracted, the right sextant was distalized using skeletal anchorage, and Piezocision was performed on teeth 14 to 17, to facilitate orthodontic movement. A connective tissue graft was performed in the anterior sextant at the same time: soft tissue reconstruction using bilaminar techniques on the left side (teeth 21 to 23) and heterologous techniques on the right side (teeth 11 to 13). The overall appearance was satisfactory at the end of treatment (Figs 3f to 3h).

## Case 3

A 52-year-old woman sought orthodontic treatment to eliminate her social and relationship complaints

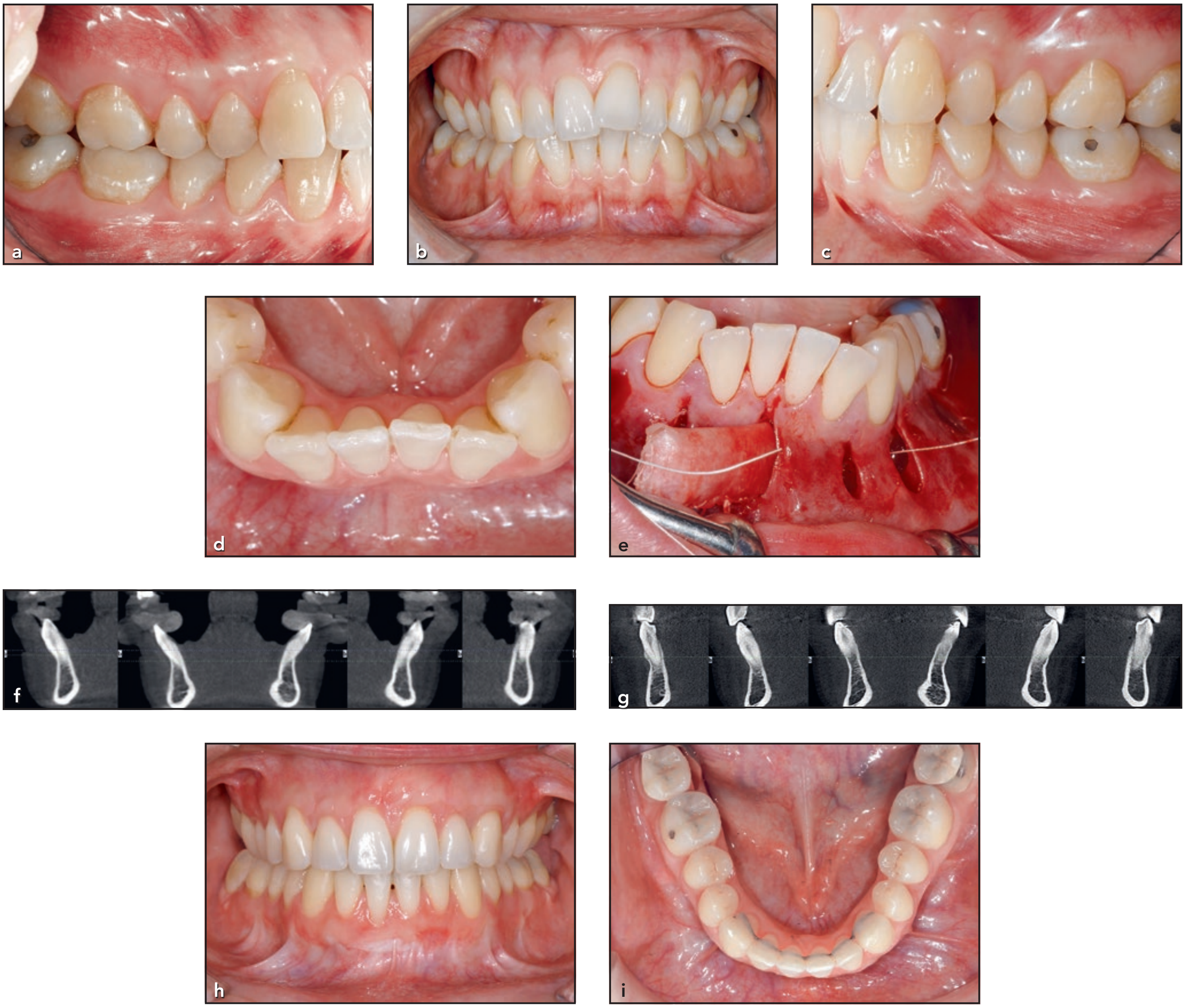

**Fig 3** *Case 2.* (a) *Right lateral,* (b) *buccal, and* (c) *left lateral views at the beginning of treatment; multiple recessions and malocclusion are noticeable.* (d) *Occlusal mandibular view. The alveolar bone profile is indicated by the yellow dotted line.* (e) *The bone bundle is placed into the tunneled site.* (f) *CBCT radiographs before and* (g) *after orthodontic treatment.* (h) *Buccal and* (i) *occlusal views at the end of treatment. Note the orthodontic movement that occurred inside the bone envelope by comparing* (d) *to* (i).

caused by her dentition. A Class I malocclusion with severe crowding in the mandibular arch, a narrow maxillary arch, and crossbite between teeth 22, 23, and 33 were detected (Fig 4a). Tooth 33 had a noticeable ectopic position (Fig 4b). An extractionless treatment plan that expanded maxillary and mandibular arches was designed. A MAPA-cision was performed from teeth 33 to 45 in the mandible and from the distal aspect of tooth 11 to the distal aspect of tooth 25 in the maxilla. At the end of treatment, the malocclusion has been resolved by the transversal expansion of both arches, achieving an adequate space for teeth alignment (Figs 4c to 4f).

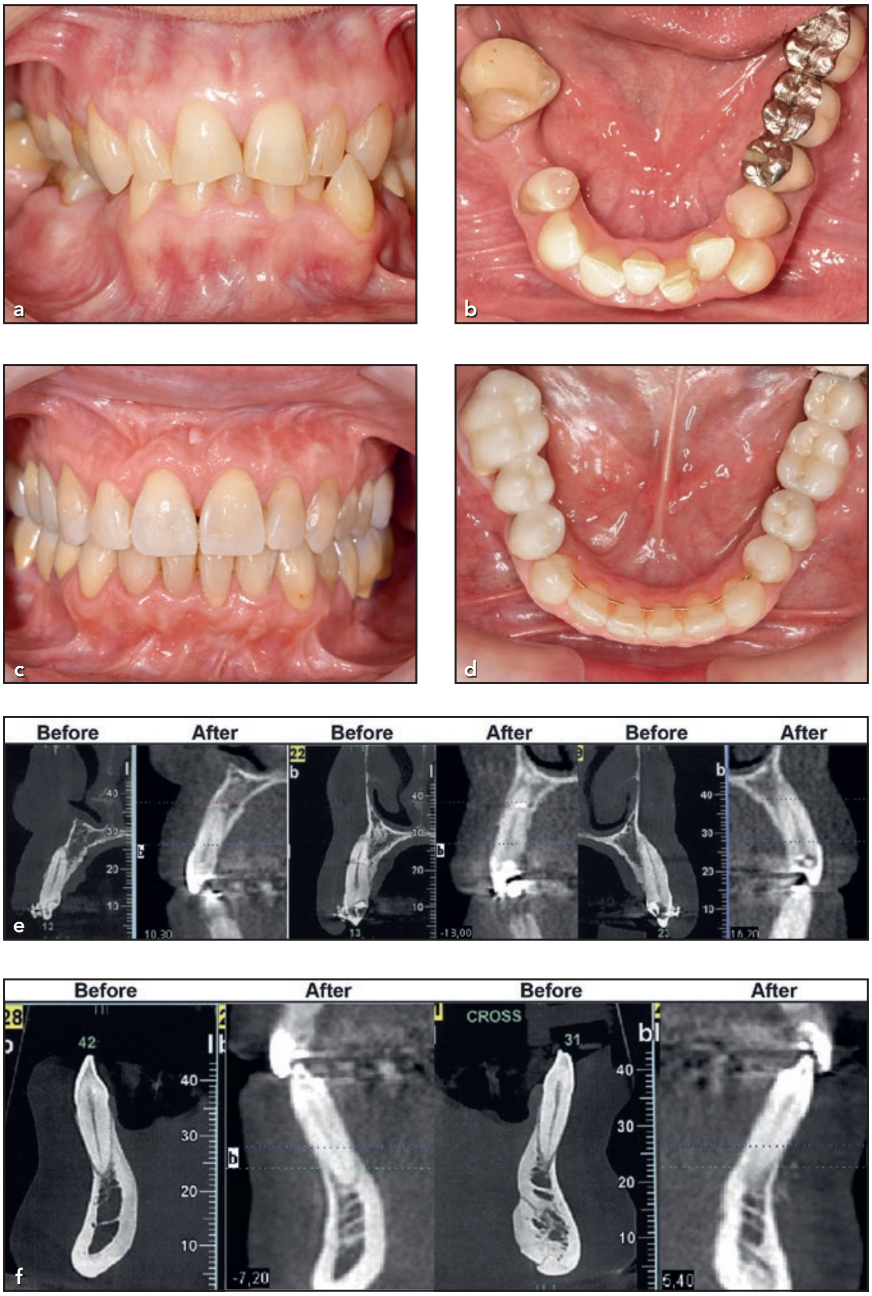


**Fig 4** *Case 3.* (a) *Buccal and* (b) *mandibular occlusal views at the beginning of treatment.* (c) *Buccal and* (d) *mandibular occlusal views at the end of treatment.* (e) *CBCT radiographs before and* (f) *after treatment. Note that no root exposure outside the cortical bone is noticeable despite the transversal expansion of both arches.*

## Discussion

Corticotomy is an intentional injury to the cortical bone and was repeatedly modified with attempts to demonstrate that, due to increased localized osteoclastic and osteoblastic activity (regional acceleratory phenomenon),[18,19] it could result in decreased bone density[20] and bone volume[21] with subsequently faster tooth movement. Depending on the flap design, surgical tools, and therapeutic goals, the surgical technique is named either PAOO,[9] MT-DLD (monocortical tooth dislocation and ligament distraction),[10] corticision,[11] or Piezocision.[12] In 2003, Wilcko et al[22] revisited their original technique, adding bone to increase the alveolar thickness. Vercellotti and Podesta[10] introduced the use of Piezosurgery with conventional flap elevation. Minimally invasive flapless approaches were described by Park et al,[23] Kim et al,[24] and Dibart et al.[12] Furthermore, Piezocision was proposed also to allow soft and hard tissue grafting where needed.[25,26]

However, in case of preexisting bone or mucogingival defects, reconstructive procedures become a priority.[27] The GBR biologic principles are based on creating and maintaining an adequate space for a blood clot and site protection during the healing process.[28] If space is maintained, cells derived from the surrounding bony structure can repopulate the protected blood clot.[29] The presence of a barrier that can prevent the proliferation of connective tissue cells, such as a resorbable membrane, could be mandatory. The MAPA-cision technique allows adequate space for bone in the desired sites by means of the bone bundle. The mineralized material is wrapped in a resorbable collagen membrane that has an intact surface, placed toward the connective tissue, and a perforated surface, which comes in contact with the cortical bone. Packed in this way, the bundle can be inserted using a tunnel technique with a minimally invasive approach. The intact surface of the membrane bone bundle prevents connective cells from the healing process, while the perforated surface (bony surface) facilitates the colonization of bone material. This new minimally invasive technique is indicated in several clinical conditions where a thickening of the bone support is required: to prepare an implant site, to increase tissue thickness in esthetic areas, as well as in association with orthodontic movements preventing bone fenestrations, dehiscences, and resulting soft tissue instability over time.

## Conclusions

MAPA-cision is a novel, minimally invasive regenerative technique designed to facilitate tooth movement, preventing orthodontically induced periodontal damages and avoiding more extensive and traumatic surgical approaches. This versatile technique can be customized to meet specific clinical requirements, making it an additional tool in the dental team's armamentarium. This case series illustrates how MAPA-cision can be used in selected patients to produce timely and satisfactory outcomes, avoiding any adverse effects to the periodontium.

## Acknowledgments

The authors declare no conflicts of interest.

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