Clinical case

Is periodontal regeneration effective in a long-term maintenance of teeth with advanced periodontitis? a case report

Ortega Concepción, Daniel
Graduate in Dentistry, Universidad Complutense de Madrid. Specialist in Oral Medicine, Universidad Complutense de Madrid.

González Febles, Jerián
Licensed in Dentistry, Universidad Complutense de Madrid. Master's in Periodontics, Universidad Complutense de Madrid

Peña Cardelles, Juan Francisco
Graduate in Dentistry, Universidad Rey Juan Carlos, Madrid. Specialist in Oral Medicine, Universidad Complutense de Madrid.

Cano Durán, Jorge A
Graduate in Dentistry, Universidad Complutense de Madrid. Specialist in Oral Medicine, Universidad Complutense de Madrid.

Figuero, Elena
Contracted Professor, Co-director of the Expert Course in Clinical Periodontics, ETEP Research Group (Etiology and Treatment of Periodontal Diseases), Universidad Complutense de Madrid School of Dentistry.

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Correspondence address:
Daniel Ortega Concepción.
Departamento de Medicina, Periodoncia y Cirugía Bucal (Estomatologia III). Facultad de Odontologia. Universidad Complutense de Madrid (UCM).
Plaza Ramon y Cajal s/n, 28040 Madrid. E-mail: daniorte@ucm.es
Tel: 616283979.

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ABSTRACT

Objective: The purpose of this article is to describe a clinical case on periodontal regeneration and to determine the efficacy and predictability of the different regenerative techniques in the treatment of intraosseous defects caused by periodontitis.

Clinical case: This is the case of a 65-year-old patient with advanced chronic periodontal disease located in the right superior central incisor where regenerative surgery was planned during the reevaluation stage due to a radiographically visible intraosseous defect with a pocket depth of 11 mm. The lesion, which affected the buccal, distal and palatal walls, was treated with a combination of bone xenograft (BGs), absorbable collagen membrane (GTR) and enamel matrix proteins (EMPs), resulting in a reduction in pocket depth up to 7 mm after nine months.

Conclusion: Periodontal regeneration has been shown to be effective for the treatment of an intra-bone defect that compromises tooth survival by helping the patient maintain proper oral health and function.

KEYWORDS

Periodontal regeneration; Enamel matrix proteins; Bone grafts; Guided tissue regeneration.

INTRODUCTION

Periodontitis is a chronic inflammatory disease of infectious origin that causes progressive deterioration and destruction of the tissues that support the tooth, made up of alveolar bone, the periodontal ligament and radicular cement.[1] The extent and severity of bone loss must be diagnosed with radiographs and clinical examination.[1, 2]

There are two types of bone loss in periodontitis: horizontal and vertical bone loss patterns. The first, in which the alveolar crest migrates horizontally towards the apex, is more common. The second form is less frequent and is usually found more locally, making these cases of vertical bone loss susceptible to regeneration techniques.[2-4]

Periodontal regeneration is defined, according to the American Academy of Periodontics (AAP), as the restoration of tissue lost due to periodontitis, including the radicular cement, periodontal ligament and alveolar bone. However, it must be made clear which types of bone defects are susceptible to regenerative surgery.[1]

According to Papapanou and Tonetti5, we can distinguish between supraosseous or horizontal defects, intraosseous or vertical defects and interradicular or furcation defects. Supraosseous defects are those found coronally to the alveolar crest. In infraosseous defects, the lesion is apical to the residual alveolar wall. Interradicular defects are those that occur in the area of separation of multiradicular tooth roots, called furcation, which leads to loss of said bone and may make the furcation clinically detectable.

Regarding infraosseous defects, these are classified as intraosseous defects and craters. In intraosseous defects, one or several walls of the same bone are affected, with the defect named according to the number of walls that are intact: single-wall defects, two-wall, three walls or combined intraosseous defects. Craters, on the other hand, are defects in which there is similar bone loss in the roots of two contiguous teeth with no bone between them[5] (Figure 1).

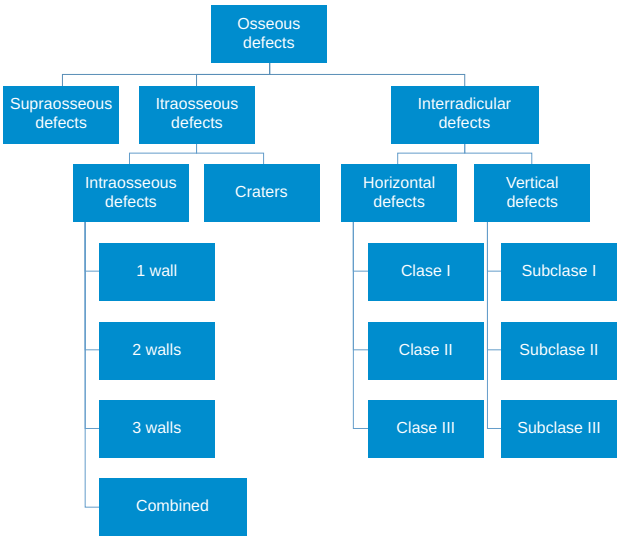

Figure 1. Classification of periodontal bone defects.

Periodontal regeneration is possible in intraosseous defects and class I and class II interadicular defects, both mandibular and maxillary. It is not predictable in horizontal or supraosseous defects, intraosseous craters or class III intraradicular defects.[6,7]

Among the most widely used regeneration techniques is guided tissue regeneration (GTR), the use of enamel matrix proteins (EMP) or the use of bone grafts (BG).

GTR consists of placing a biocompatible membrane between the epithelium and connective tissue of the defect, which can be to serve as a physical barrier, acting as a cellular exclusion mechanism, thereby promoting the migration of cells from the periodontal ligament and impeding the entry of epithelial cells.[8-10]

EMPs, extracted from embryonic enamel of young pigs, are not a physical barrier per se, but rather a material in gel form that is placed precisely inside the defect, promoting true periodontal regeneration. EMPs modulate tissue regeneration, simulating events that occur during formation of the root and promoting the formation of new alveolar bone, radicular cement and periodontal ligament. Among the properties of EMPs are its antimicrobial ability and inhibition of epithelial migration by direct contact.[3, 11, 12]

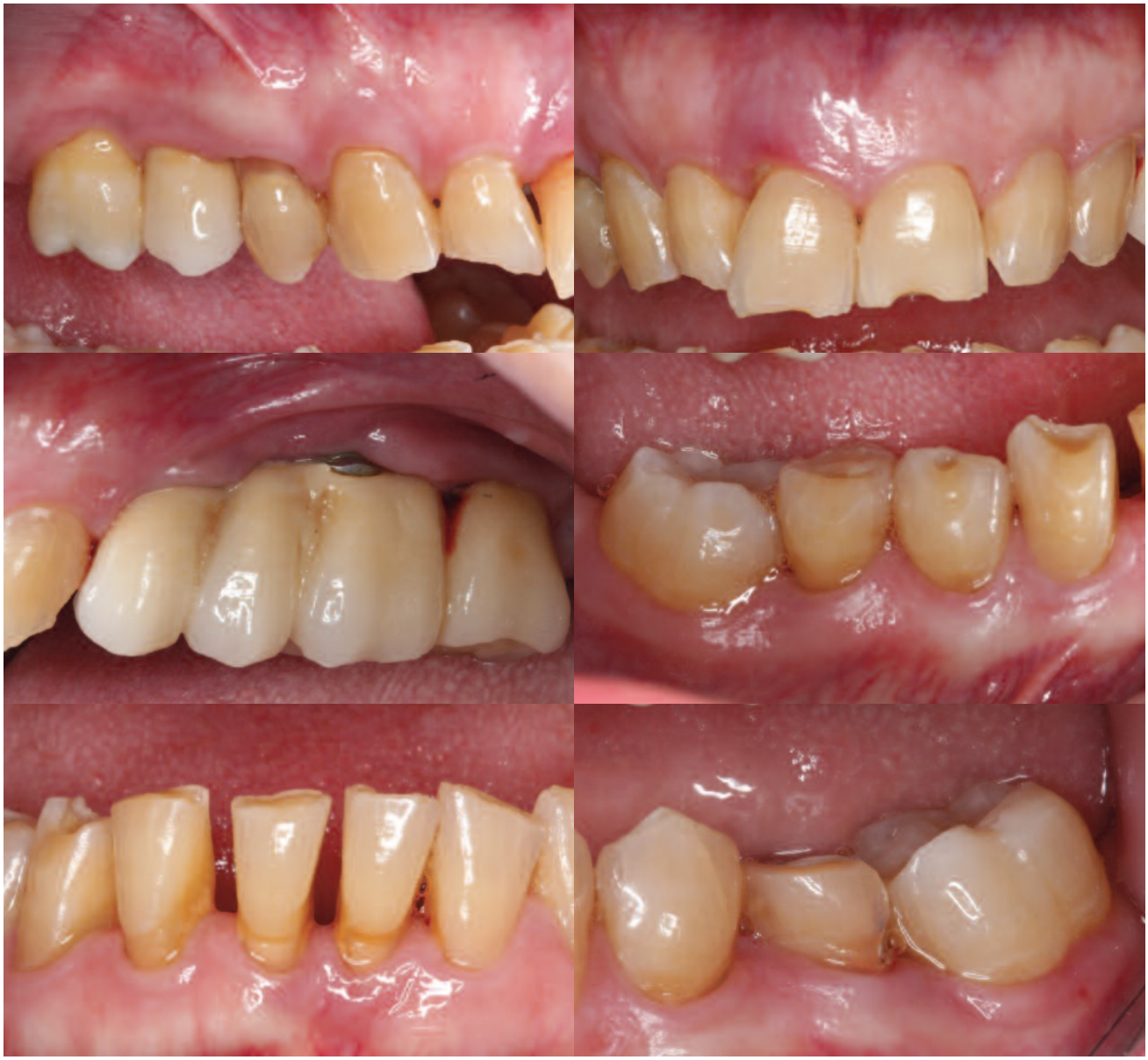

Figure 2. Initial photographs by sextants.

BGs can be obtained from the patient (autograft), another human (allograft), another animal species (xenograft) or from alloplastic materials. The BGs most widely used in periodontal regeneration are bone xenografts extracted from lyophilized bone usually of bovine origin. Regarding the application of BGs alone in periodontal regeneration, it has been shown that they are ineffective in achieving satisfactory results, so they are used in combination with GTR and EMP. The combination of EMP+BG and GTR+BG shows additional improvement in the reduction of pocket depth and gains in clinical insertion versus EMP or membranes alone, though the results in some cases are not significant.[6,10,13]

The purpose of this article is to describe a clinical case on periodontal regeneration and to determine the efficacy and predictability of the different regenerative techniques in the treatment of intraosseous defects caused by periodontitis.

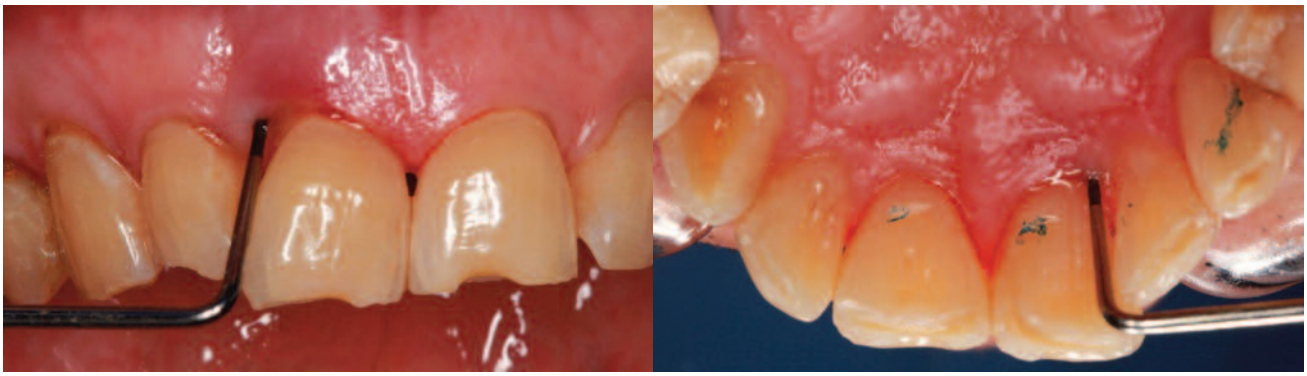

Figure 3. Photograph of the pocket in RSCI.

CLINICAL CASE

This is the case of a 65-year-old retired male who was referred to the periodontics clinic for a possible endo-periodontal lesion of the right superior central incisor (RSCI).

The history is significant for mild sleep apnea-hypopnea syndrome (SAHS) and hypertension, currently treated with Enalapril 20 mg. This is therefore an ASA type II patient.

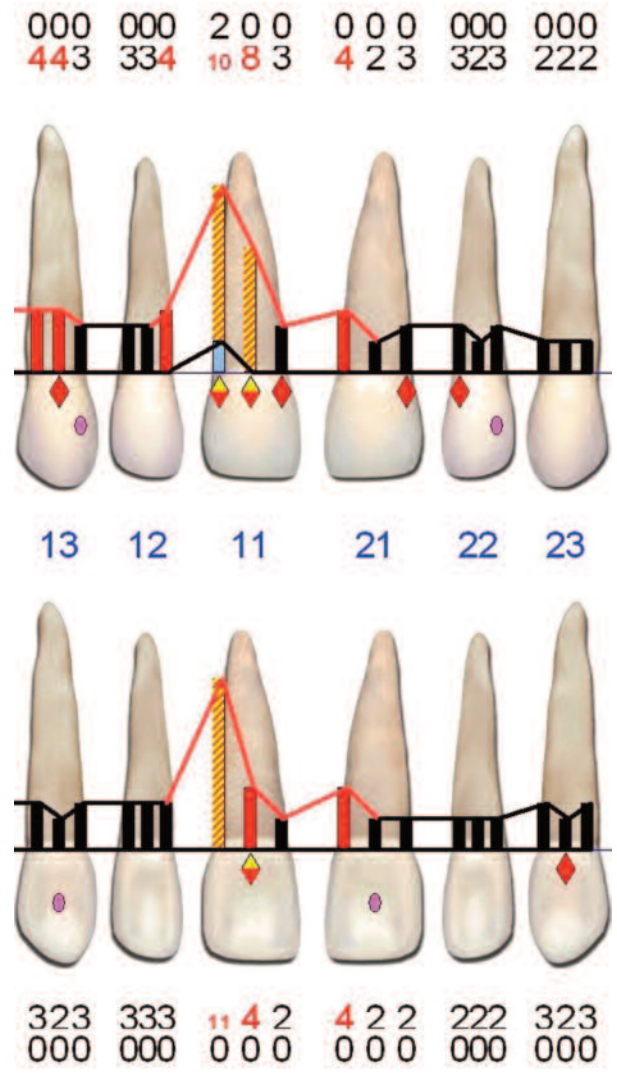

Figure 4. Initial periodontogram of the second sextant.

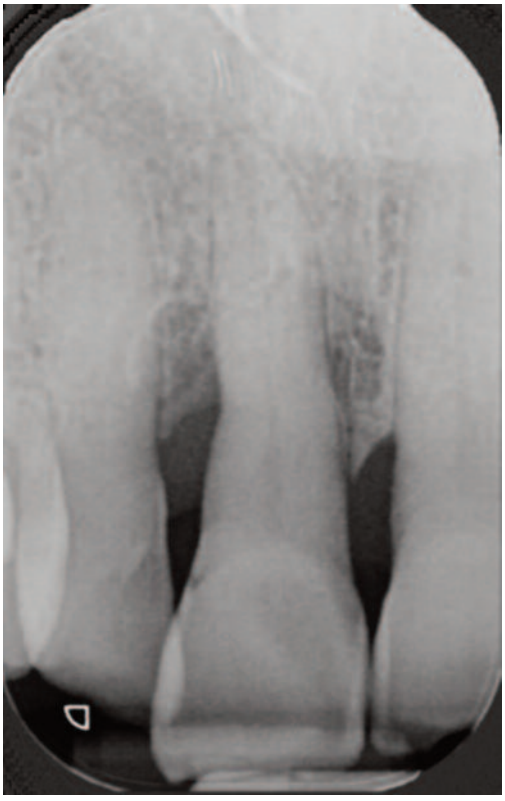

Figure 5. Initial periapical radiograph of the RSCI.

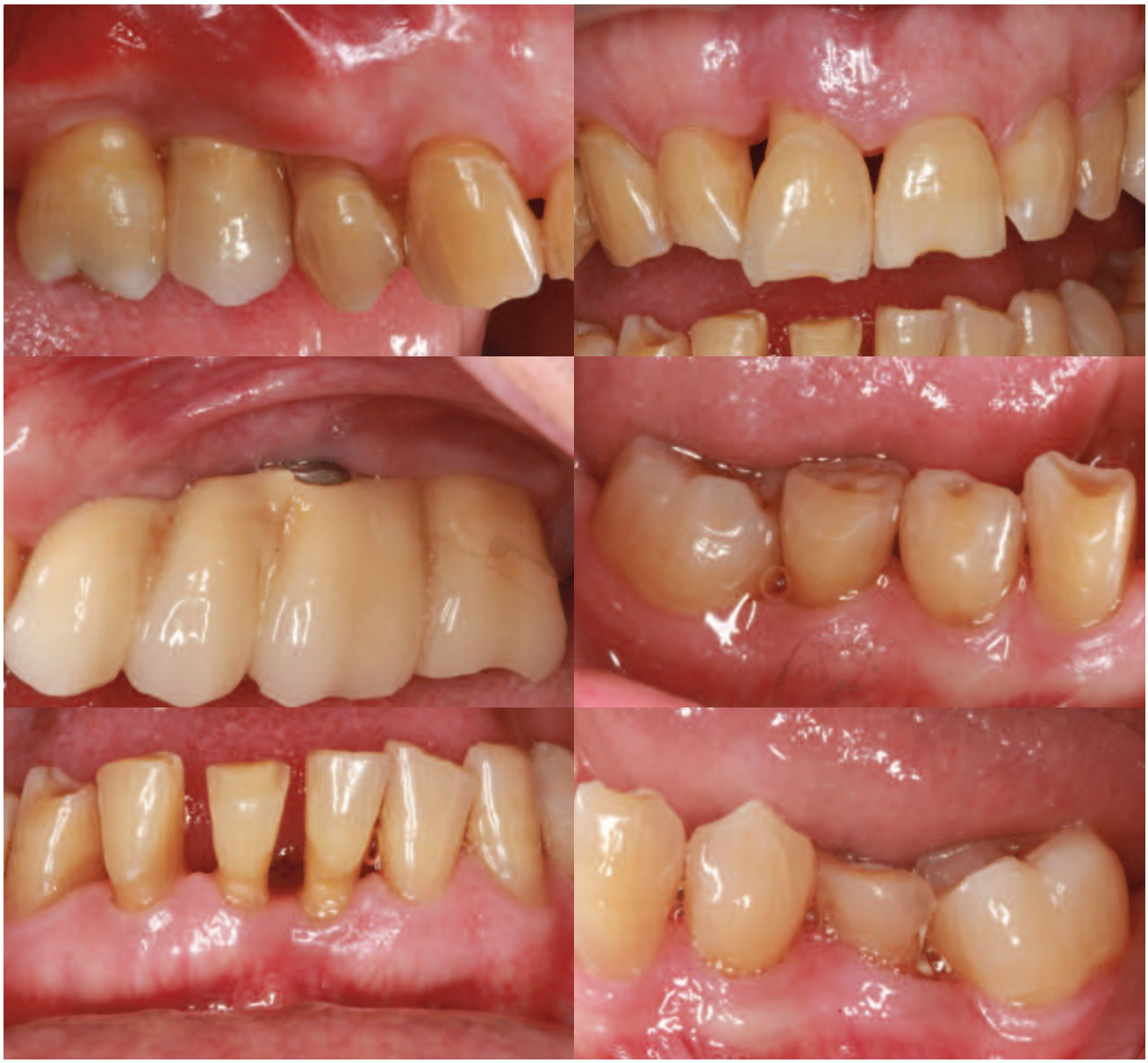

Figure 6. Photographs by sextants after post-RAR reevaluation.

Examination and diagnosis

Intraoral examination revealed an increased overbite, generalized abrasions and anterior attrition due to bruxism. From a periodontal point of view, there were generalized vestibular recessions and

gingival inflammation, plaque and calculi accumulation in all the posterior sectors. Regarding the patient's implants, there were some cemented crowns that were over-routed and poorly fitted at the gingival margin which had resulted in difficulty maintaining oral hygiene in this area (Figure 2).

A complete periodontogram was carried out which revealed pocket depths up to 6 mm, primarily in the molars and premolars, and pocket depths of up to 9 mm in the third sextant implants, as well as detectable furcation lesions in the first inferior and superior molars, 40% plaque and 37% bleeding. In addition, the RSCI revealed a localized pocket depth of 10 mm

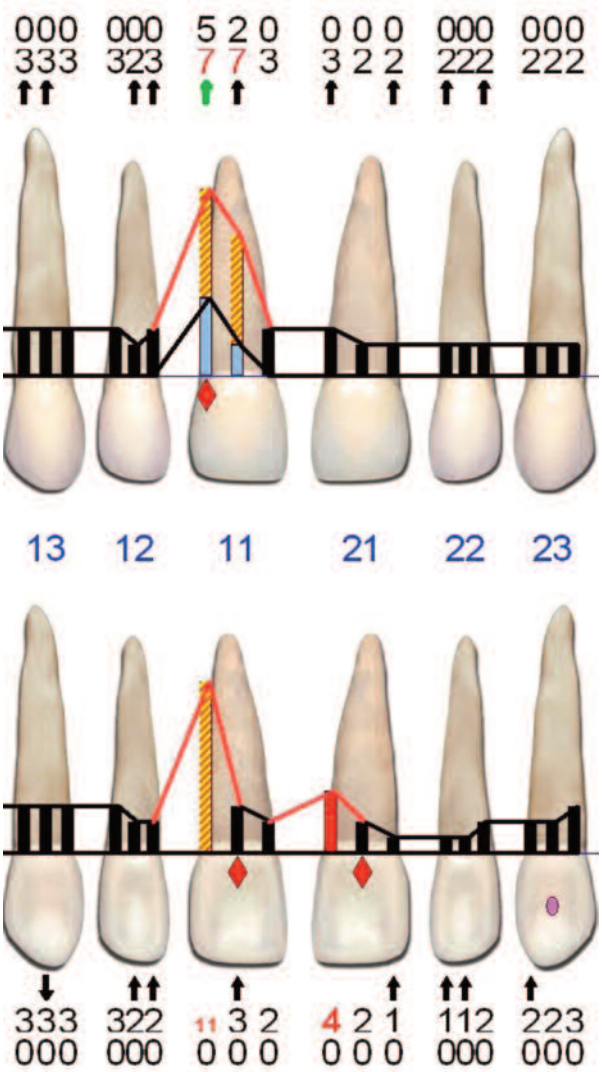

Figure 7. Periodontal chart of the second sextant after reevaluation.

distovestibular, 8 mm mesiovestibular and 11 mm distopalatal, suspicious for a possible endoperiodontal lesion, given the magnitude of the loss in that tooth. In addition, there was bleeding, suppuration and type-I mobility (Figures 3 and 4).

Clinically, the right superior central incisor (RSCI) was mildly vestibulized with respect to the left central, leading to the suspicion that there may be occlusal trauma at that level. Radiographic examination revealed a moderate generalized bone loss pattern with no bone loss at the implants. The RSCI exhibited a marked

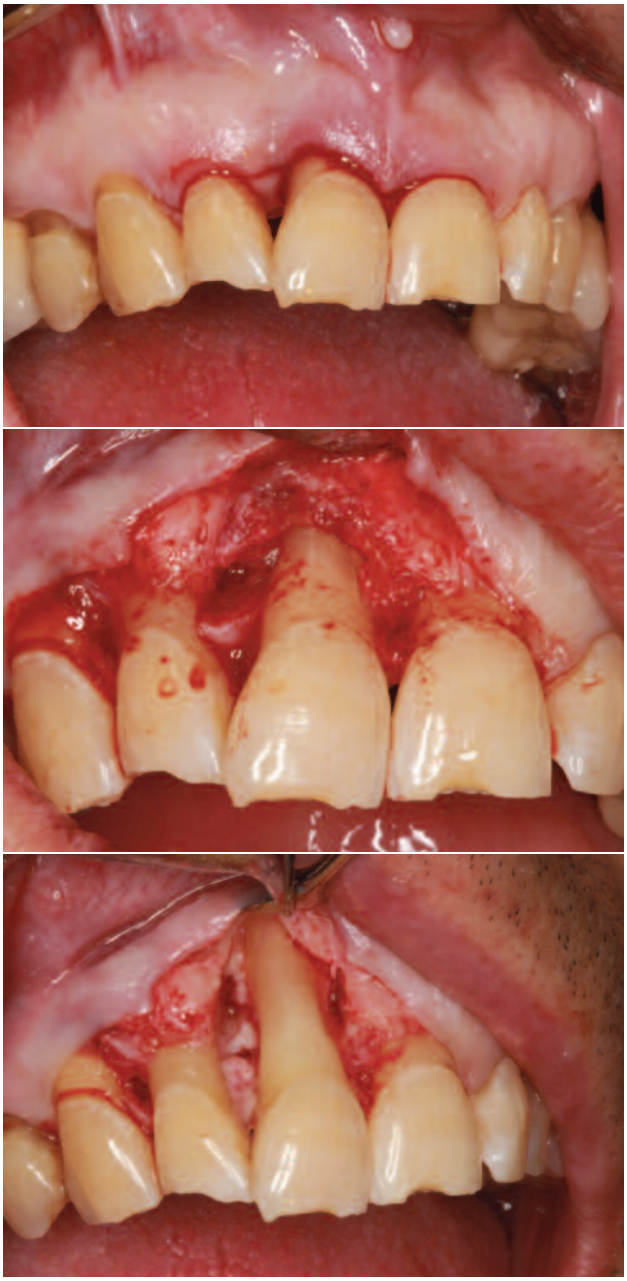

Figure 8. Photos of the surgery. Incision, detachment and cleaning of the defect.

intraosseous defect that involved almost the entire tooth (Figure 5). In addition, vitality tests were negative.

Microbiological samples were taken from each sextant, revealing the presence of Prevotella intermedia, Porphyromonas gingivalis, Fusobacterium nucleatum in a proportion of 18.19%, 33.59% and 1.59% of the entire oral microflora, respectively (6.288x108 CFU).

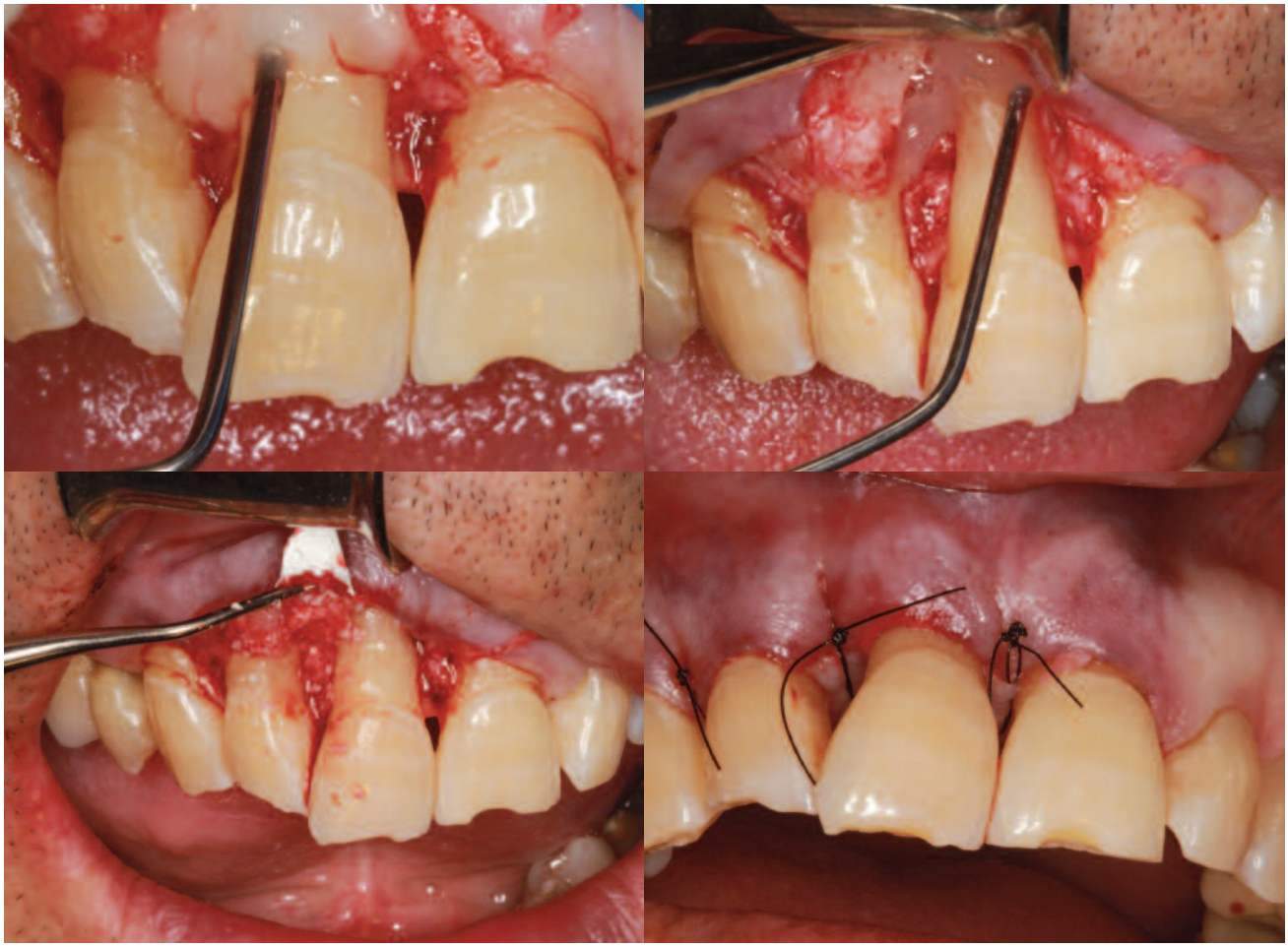

Figure 9. Photos of the surgery. Application of enamel matrix proteins, absorbable collagen membrane and xenograft. Suture.

After clinical and radiological examination, it was concluded that the patient had moderate generalized/advanced localized periodontitis and peri-implant mucositis.

Prognosis

A favorable prognosis was made for all of the teeth except the RSCI, which was given a poor prognosis due to the loss of periodontal support.

Treatment plan

After analyzing the occlusion, the presence of rubbing detected in the RSCI was relieved by selective sculpting on the palatal surface of the tooth. The basic phase of periodontal treatment was carried out, consisting of instructions on oral hygiene, professional prophylaxis, radicular filing and polishing, 0.12% chlorhexidine + 0.05% cetylpyridine chloride rinses (Perio-aid®; Barcelona, Spain) every

12 hours for 2 weeks, in addition to a prescription for metronidazole 500 mg every 8 hours for 7 days due to the presence of P. gingivalis.

Reevaluation at one month revealed clear improvement of inflammation, plaque and bleeding, reduced up to 15 and 19%, respectively (Figure 6).

However, given the limitations of basic periodontal treatment, especially in the deep pockets of more than 6 mm, the RSCI maintained high pocket depths, 7 mm distovestibular with a 5 mm recession (10 and 2 mm at baseline, respectively) and 11 mm distopalatal (Figure 7).

Therefore, given the clinical and radiographic findings,

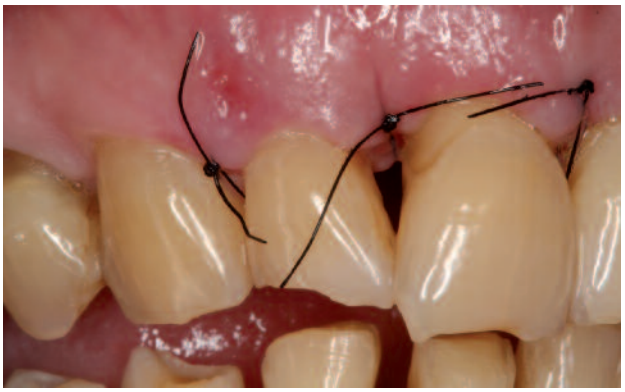

Figure 10. Healing at one week after surgery.

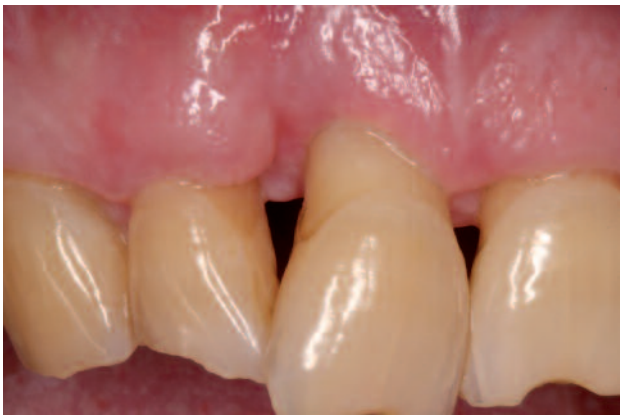

Figure 11. Healing at one month after surgery.

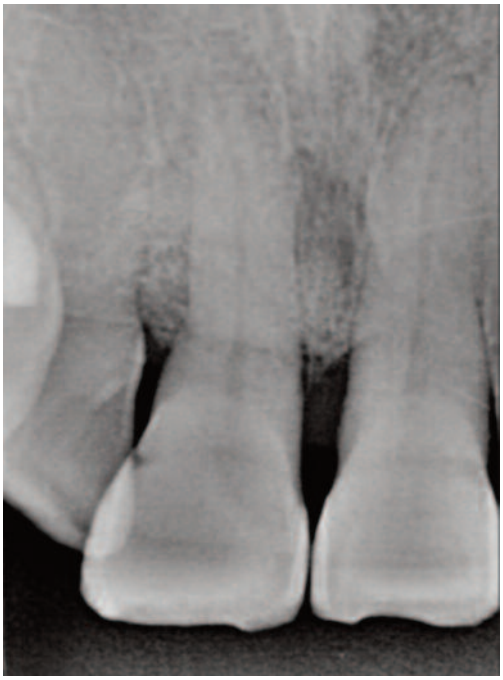

Figure 12. Follow-up periapical radiograph at 2 months after surgery.

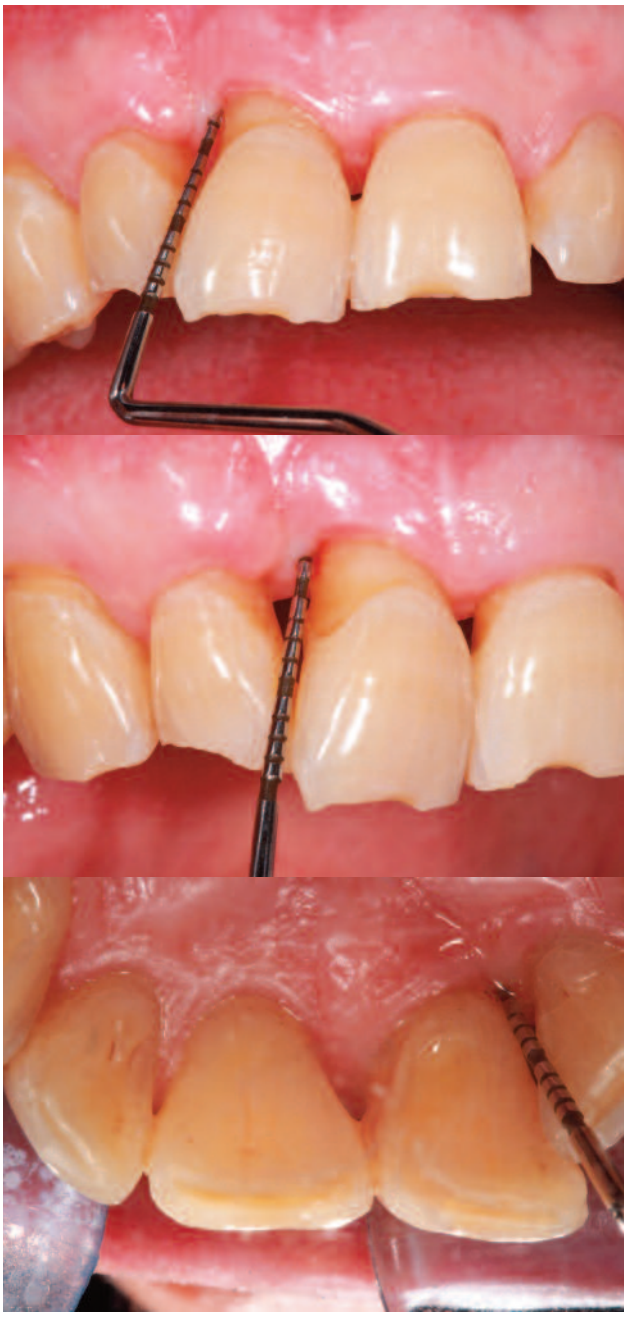

Figure 13. Photograph of pocket at 9 months after surgery.

a regenerative surgery was selected for the RSC., This procedure was thus indicated aimed to improve the prognosis of the RCSI and to achieve healthy pocket depths.

A simplified papilla preservation technique was used in interdental spaces of less than 2 mm and a modified

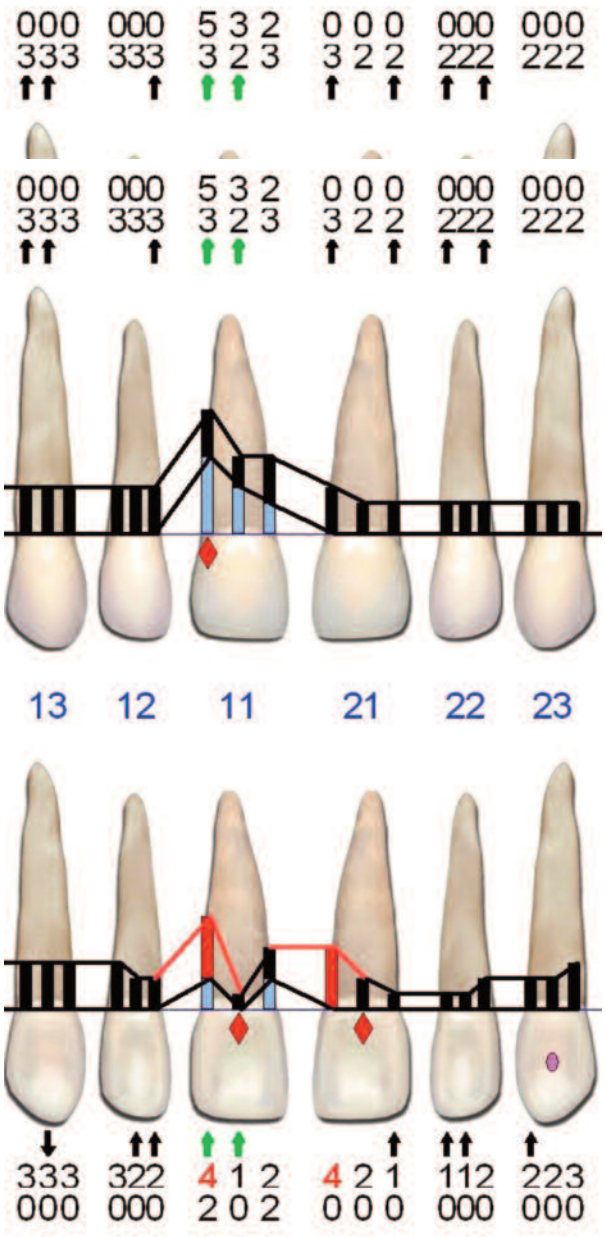

Figure 14. Periodontal chart of the second sextant at 9 months after surgery.

papilla technique for interdental spaces greater than 2 mm. After complete thickness separation and elimination of granulation tissue, an intraosseous defect was observed with complete loss of the vestibular bone, the distal wall and part of the palatal wall of the RSCI that extended almost to the apex. Given the importance of the lesion, a combined technique using guided tissue regeneration (GTR) using absorbable collagen membrane, bovine bone xenograft (Bio-Oss®) and enamel matrix proteins (Emdogain®) was proposed in order to reconstruct the lost vestibular bone (Figures 8 and 9).

Table 1. Clinical trials that use GTR or GTR + BG.

Study	Time (months)	Treatment (number of defects)	Mean reduction in PD[1] (mm)	P	Mean GCI[2] (mm)	P
Sculean et al.[14] (2008	12	PMEs (10)	4.1	<0.001	3.4	<0.001
		RTG (10)	4.2	<0.001	4.2	<0.001
		PMEs + RTG (9)	4.3	<0.001	3.3	<0.001
		CAD (9)	3.7	<0.001	2.0	<0.001
	120	PMEs (10)	4.6	NS3	2.9	<0.001
		RTG (10)	3.4	NS3	2.8	<0.001
		PMEs + RTG (9)	3.6	NS3	2.9	<0.001
		CAD (9)	3.5	NS3	1.8	<0.001
Siciliano et al[15] (2011)	12	RTG (20)	5.5	<0.001	4.1	<0.001
		PMEs (20)	2.9	<0.001	2.4	<0.001
Nygaard-Østby et al.[16] (2010)	9	IOs (20)	2.9	<0.05	2.5	<0.05
		IOs + RTG (20)	3.2	<0.05	2.5	<0.05
	120	IOs (13)	2.7	<0.05	2.2	<0.05
		IOs + RTG (13)	4.2	<0.05	3.8	<0.05
Slotte et al.[17] (2007)	12	RTG + IOs (52)	5.2	ND[4]	4.2	ND[4]
	36		5.6	ND[4]	4.1	ND[4]
	60		5.3	ND[4]	4.3	ND[4]
Cortellini et al.[18] (2011)	12	RTG (25) Ext/implante	8.8	<0.001	7.7	<0.001
			ND[4]	ND[4]	ND[4]	ND[4]
	60	RTG (25) Ext/implante	8.9	NS[3]	7.7	NS[3]
			ND[4]	ND[4]	ND[4]	ND[4]

[1] Pocket Depth; [2]Gained Clinical Insertion; [3]Not significant; [4]Not defined.

Follow-up and outcomes

After the surgery, weekly follow-up visits were scheduled in the first month, and prophylaxis of the area was carried out at each visit. Brushing was prohibited in the first week, restarting after the first seven days after removal of the sutures (Figure 10). After one month, healing of the area was very satisfactory (Figure 11). After the first month, follow-up visits were carried out every 3 months, emphasizing the importance of good hygiene, especially at the interproximal level.

A detailed reevaluation was performed nine months after regenerative surgery.

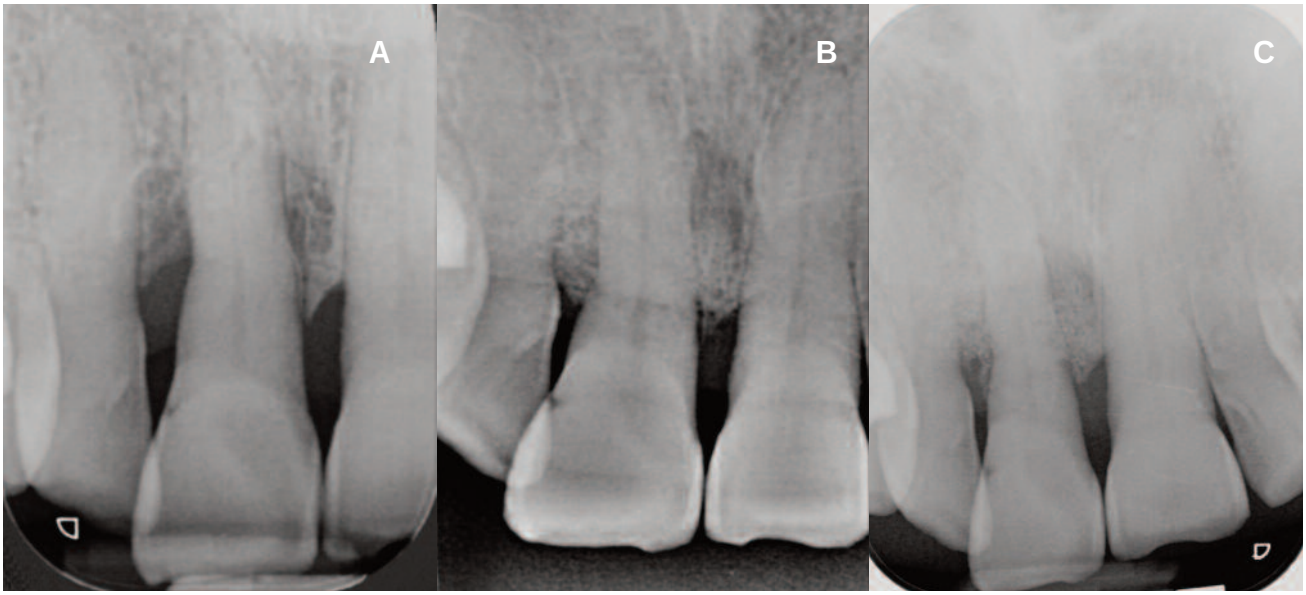

Figure 15. Radiographic progression of the case up to 9 months after surgery: a. Initial radiograph; b. Radiograph at 2 months; c. Radiograph at 9 months.

A periapical radiograph of the RSCI revealed radiographic bone refilling of the entire defect. Clinically, the pocket depth in the area was measured, revealing 2 mm mediovestibular, 3 mm distovestibular and 4 mm distopalatal, with a reduction in pocket depth of 6 and 7 mm, respectively, for vestibular depts and 7 mm for palatal compared to baseline. As expected after periodontal treatment that involved a reduction in gingival inflammation, an 2 mm distoplanal and 3 mm distovestibular and mediovestibular increase in the recession was observed (Figures 12-15).

DISCUSSION

In this case we were able to achieved a reduction in pocket depth of up to 7 mm and a notable gain in the clinical insertion depth of the defect that reached up to 5 mm distopalatal. This demonstrates the efficacy of periodontal regeneration in the treatment of teeth with advanced periodontitis and a poor prognosis.

Regarding this case, a limited search of the literature on periodontal regeneration over the last 10 years was carried out, revealing that the regenerative treatment of

Table 2. Clinical trials that use GTR or GTR + BG

Study	Time (months)	Treatment (number of defects)	Mean reduction in PD[1] (mm)	P	Mean GCI[2] (mm)	P
Grusovin et Esposito[19] (2009)	12	PMEs (15) CAD (15)	4.2 3.9	NS[3]	3.4 3.3	NS[3]
Chambrone et al.[20] (2010)	12	PMEs CAD	4.00 3.49	NS[3]	3.46 3.65	NS[3]
	24	PMEs CAD	4.21 3.28	<0.05	5.69 5.24	NS[3]
Sculean et al.[21] (2007)	48	PMEs (12) PMEs + IOs (13)	4.2 4.1	NS[3]	3.4 3.4	NS[3]
Kuro et al.[22] (2006)	8	PMEs (26) PMEs + IOs (26)	5.03 5.73	<0'05	4.06 5.17	<0.05
Cortellini et al.[18] (2011)	12	PMEs (25) Ext/implante	8.3 ND[4]	<0.001 ND4	7.8 ND[4]	<0.001 ND[4]
	60	PMEs (25) Ext/implante	8.7 ND[4]	NS[3] ND[4]	8.1 ND[4]	NS[3] ND[4]
Sculean et al.[14] (2008)	12	PMEs (10) RTG (10) PMEs + RTG (9) CAD (9)	4.1 4.2 4.3 3.7	<0.001 <0.001 <0.001 <0.001	3.4 4.2 3.3 2.0	<0.001 <0.001 <0.001 <0.001
	120	PMEs (10) RTG (10) PMEs + RTG (9) CAD (9)	4.6 3.4 3.6 3.5	NS[3] NS[3] NS[3] NS[3]	2.9 2.8 2.9 1.8	<0.001 <0.001 <0.001 <0.001

[1]Pocket Depth; [2]Gained Clinical Insertion; [3]Not significant; [4]Not defined

Table 3. Clinical trials that compare GTR vs. EMP

Study	Time (months)	Treatment (number of defects)	Mean reduction in PD[1] (mm)	P	Mean GCI[2] (mm)	P
Sculean et al [23] (2006)	12	PMEs (10) RTG (10)	4.1 4.6	NS[3]	3.2 3.0	NS[3]
	96	PMEs (10) RTG (10)	3.4 3.7	NS[3]	2.8 2.9	NS[3]
Crea et al.[24] (2008)	12	PMEs (19) RTG (20)	3.5 3.5	NS[3]	2.9 2.5	<0.05
	36	PMEs (19) RTG (20)	3.1 3.2	NS[3]	2.4 2.0	<0.05
Siciliano et al .[15] (2011)	12	PMEs (20) RTG (20)	2.9 5.5	<0.001	2.4 4.1	<0.001
Siciliano *et al .*[25] (2014)	12	PMEs + BG (20) RTG + IOs (20)	4,6 4,4	NS[3]	3,8 3,7	NS[3]

[1] Pocket Depth; [2]Gained Clinical Insertion; [3]Not significant; [4]Not defined.

intraosseous defects that resulted from progression of periodontitis is a predictable therapeutic procedure that has been widely studied in the field of periodontics.[3-32]

There are currently two main techniques in regenerative periodontal therapy: GTR and the use of EMPs, alone or in combination with BG. The efficacy of these two procedures have been evaluated separately in comparison with the Open Flap and Debridement (OFD), used alone or in combination with BG, as well as other studies that compare both techniques (Tables 1 to 3).

GTR, commonly using absorbable collagen membranes, is a procedure that has been shown in recent years to provide results superior to OFD, both in reducing pocket depth and in gains in clinical insertion. This has been shown in the recent publication by Sculean et al.[14] in which, though a very similar reduction in pocket depth was found for both GTR and OFD, a greater clinical insertion of up to 2.2 mm was seen in cases treated with GTR. In the study by Siciliano et al.[15], results favoring the use of GTR over OFD were also found, with a reduction in pocket depth of up to 5.5 mm and a gain in clinical insertion of between 3.2 and 4.1 mm. The papers published by Nygaard-Østby et al.[16] and Slotte et al.[17] which employed GTR and BG together revealed that the combination of collagen membranes together with bone xenografts provides significant improvement in reducing pocket depth and gaining clinical insertion compared to the use of both techniques separately (Table 1).

Regarding enamel matrix proteins, the first article to compare the effectiveness of EMP versus the OFD procedure was published by Heijl et al.[26] in 1997 in which the authors observed a statistically significant reduction of pocket depth and gains in clinical insertion favoring EMPs. Subsequently, the studies by Grusovin and Esposito[27] and Chambrone et al.[28] compared the efficacy of EMP versus OFD, primarily in three-wall defects6, showed a reduction in pocket depth of up to 5 mm and a gain in clinical insertion of between 3.4-5.6 mm. These results are very similar to those obtained using GTR, although it has been shown that treatment with EMP has a lower number of postoperative complications and, therefore, lower morbidity compared to GTR29. The study published by Sculean et al.[21] evaluated the efficacy of the EMP+BG combination. This study failed to demonstrate a statistically significant difference against EMP alone. However, the article published by Kuro et al.[22] revealed that the combination of EMP+BG resulted in a greater reduction in pocket depth and, especially, a greater gain in clinical insertion 8 months after surgery. In the systematic review y meta-analysis by Matarasso et al.[13] published in 2015 on the use of EMP and BG, the authors analyzed a total of 20 studies and 548 intraosseous defects. It was observed that the combination of EMP + BG provided additional improvement in gain in clinical insertion (3.76±1.07 mm after treatment with EMP + BG vs 3.32±1.04 mm after treatment with EMP alone) and pocket depth (4.22±1.20 mm after treatment with EMP + BG vs 4.12±1.07 mm after treatment with EMP alone). These data suggest that the use of EMP combined with BG should be evaluated based on the morphology of the defect, since combined use does not necessarily lead to better outcomes. In the randomized trial published by Siciliano in 2014[25], EMP and GTR were compared, both combined with BG. The authors did not find statistically

significant differences between procedures with regards to pocket depth and gain in clinical insertion. However, outcome was slightly better in the EMP + BG group (Tables 2 and 3).

Therefore, for the use of xenografts, both combined with GTR or EMPs, the most recent literature indicates that in many cases, the addition of a BG does not provide truly significant improvements in reducing pocket depth and gaining clinical insertion. This indicates that the use of bone xenografts is not really necessary in certain cases of intraosseous defects and outcome will depend on its morphology.[14,21,30,31] In addition, it is important to keep in mind the number of complications related to both technologies. Sanz et al.[32] observed a 100% complication rate associated with GTR compared to a 6% in EMP. Conversely, one should consider whether the clinical outcomes would improve by combining the use of the three techniques in periodontal regeneration. In a study by Lekovic et al.[33] published in 2001, the combination of EMP + GTR + BG was compared to OFD in the treatment of different intraosseous defects. The authors achieved a reduction in pocket depth of 4.95±1.52 mm and a gain in clinical insertion of 3.89±1.16 mm. However, this study should ideally compare the results of this combination against a positive control group in which the defects would be treated with GTR, currently the gold standard. Therefore, methodological issues preclude a definitive conclusion.

Conversely, all intraosseous defects are not equal nor istheir prognosis. Often times, bone loss around some teeth is very extensive, where the prognosis for said teeth can be very poor to non-viable, thereby leading to extraction. y cols.[18] Given the efficacy of periodontal regenerative therapy in deep intraosseous defects 60 Ext/implante also be effective in teeth with a very poor or non-viable prognosis. Cortellini et al.[18] carried out a randomized clinical trial that compared regenerative treatment of teeth with advanced periodontitis and a poor or even impossible prognosis to extraction of those teeth and subsequent treatment with implants. Different techniques were used in regenerative treatment, including the combination of GTR + EMP + BG, in very deep circumferential defects with loss of various walls, obtaining results of up to 12 mm in reduction of pocket depth and more than 10 mm in gain in clinical insertion. After completion of the study, they did not find differences in comfort, both in function and esthetics in both groups. In the clinical case presented (a RSCI with a very poor prognosis), there was a circumferential three-wall defect with extension almost to the apex and loss of the entire vestibular plate. Given the complexity of the case, and in an attempt to achieve an ideal regeneration of all of the walls of the defect including the external plate, it was decided to use, according to the article by Cortellini et al.18 in which very similar cases were treated, a combination of absorbable collagen membrane, bone xenograft and enamel matrix protein. This treatment achieved a reduction in pocket depth of 7 mm and a gain in clinical insertion of up to 5 mm, thereby obtaining healthy values and improving the tooth's prognosis.

These results demonstrate that, even in the most severe cases, periodontal regeneration is truly effective and may be considered as a real alternative to extraction in teeth with severely affected periodontal support. However, one must keep in mind that the combination of the three techniques significantly increases the cost of treatment, so this article should not be taken to suggest that it is the treatment of choice but rather reserved for very advanced disease states.

CONCLUSIONS

Periodontal regeneration has been shown to be effective in the treatment of vertical intraosseous defects, including teeth with a poor prognosis.

The combination of GTR + BG, EMP + BG has led to a benefit in outcomes and prognosis, which should be selected based on the amount of loss and the characteristics of the defect. However, the higher level of complexity with the technique and especially the higher cost makes the combination of the three periodontal regeneration materials reserved only for very specific cases and always with the patient's consent.

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