

Periodontal regeneration by minimally invasive procedures and its influence on pulp status

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ABSTRACT

Dental pulp and periodontium have different communication routes including, e.g., apical foramen, accessory canals and dentin tubules. Scaling, planing and root surface treatment with ethylenediaminetetraacetic acid (EDTA)-based conditioner are used in regenerative periodontal procedures. Such treatment may generate pathological communication between the two structures due to interruption of the vascular pedicle or migration of bacteria and/or inflammatory byproducts from deep periodontal pockets, which may generate pulp pathology. **Aim:** The aim of this study was to evaluate the influence of minimally invasive periodontal regenerative surgery on pulp vitality status in single-rooted and multi-rooted teeth associated to infraosseous defects extending to the middle and apical thirds. **Materials and Method:** This was a retrospective study on 30 teeth from 14 patients who received care between August 2018 and August 2019 at the postgraduate Department of Specialization in Periodontics of the Buenos Aires University School of Dentistry (FOUBA). Clinical and radiographic endodontic diagnosis was performed 6 months after the minimally invasive regenerative periodontal treatment. **Results:** Only two out of the 30 teeth presented changes in pulp status following regenerative periodontal procedure: irreversible pulpitis at 30 days and pulp necrosis at 180 days post-treatment. The rate for risk of change in pulp vitality status was 6.7%. Teeth with grade I and II furcation lesions ($n=9$) presented no change in pulp status. **Conclusions:** Regenerative periodontal surgery had no significant influence on pulp status in single-rooted and multi-rooted teeth with infraosseous defects extending to the level of the middle and apical third.

Keywords: pulp status - pulpitis - necrosis - MIST- M-MIST.

Regeneración periodontal a través de procedimientos mínimamente invasivos y su influencia en el estado pulpar

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RESUMEN

La pulpa dental y el periodonto presentan diferentes vías de comunicación. El foramen apical, los conductos accesorios y los túbulos dentinarios son ejemplos de ellos. Durante los procedimientos periodontales regenerativos se realiza el raspaje, alisado y tratamiento de la superficie radicular con un acondicionador a base de ácido etilendiaminotetraacético (EDTA). Este tratamiento podría generar una comunicación patológica entre ambas estructuras debido a la interrupción del pedículo vascular o a la migración de bacterias y/o subproductos inflamatorios provenientes de bolsas periodontales profundas que generen patología pulpar. **Objetivo:** El objetivo del presente estudio fue evaluar la influencia de la cirugía periodontal regenerativa mínimamente invasiva sobre el estado de vitalidad pulpar de piezas dentarias unirradiculares y multirradiculares con defectos infraóseos que se extendían hasta el tercio medio y apical. **Materiales y Método:** Se analizaron de forma retrospectiva 30 piezas dentarias de 14 pacientes atendidos entre el mes de agosto 2018 y agosto 2019 en el posgrado de la Especialización en Periodoncia de la Facultad de Odontología de la Universidad de Buenos Aires (FOUBA). Se realizó el diagnóstico endodóntico de forma clínica y radiográfica a los 6 meses post-tratamiento periodontal regenerativo mínimamente invasivo. **Resultados:** De las 30 piezas solo 2 presentaron cambios en el estado pulpar luego del procedimiento periodontal regenerativo, pulpitis irreversibles a los 30 días y necrosis pulpar a los 180 días post-tratamiento. La tasa de riesgos de cambios en el estado de vitalidad pulpar fue del 6,7%. En relación a las piezas dentarias que presentaban lesiones de furcación grado I y II ($n=9$) ninguna presentó cambios en su estado pulpar. **Conclusiones:** La cirugía periodontal regenerativa no tuvo influencia significativa en el estado pulpar de piezas unirradiculares y multirradiculares con defectos infraóseos que se extendían a nivel del tercio medio y apical.

Palabras clave: estado pulpar - pulpitis - necrosis - mist, m-mist.

INTRODUCTION

The dental pulp and periodontium have different communication routes, including, e.g., apical foramen, accessory canals (which are more prevalent in the apical third) and dentin tubules¹. Scaling, planing and root surface treatment with an EDTA-based conditioner are used in minimally invasive regenerative periodontal procedures. Such treatment may generate pathological communication between the two structures due to interruption of the vascular pedicle or migration of bacteria and/or inflammatory byproducts from deep periodontal pockets, which may generate pulp pathology².

In 2013, De Sanctis conducted a retrospective study to evaluate the influence of regenerative periodontal surgery on pulp vitality status in teeth with defects involving the apical third, concluding that periodontal surgery did not imply risk of pulp necrosis and that it was not necessary to perform a preventive endodontic treatment unless the periodontal lesion surpassed the apical foramen such that the vascular pedicle would be interrupted during instrumentation³.

This study agrees with the results published in 2011 by Cortellini and Tonetti following evaluation of 208 teeth (167 vital and 41 non-vital) associated to infraosseous defects treated by guided tissue regeneration (GTR) procedures. Long-term follow-up (5.4 ± 2.8 years) showed that 165 of the 167 teeth were still vital, so it was concluded that despite the high prevalence of lateral canals in the middle and apical thirds, instrumentation of these areas during GTR procedures did not cause pathological changes in pulp vitality status⁴.

In multi-rooted teeth, the presence of deep pockets and loss of attachment are likely to expose lateral canals located at the level of the furcation area⁵. In 2020, Cortellini performed a study to evaluate the outcomes of minimally invasive regenerative periodontal surgery in molars with infraosseous defects combined with furcation lesions, demonstrating that it was possible to achieve clinical improvements at the furcation area level both vertically and horizontally⁶.

To date, there is no published study evaluating the effect of minimally invasive (MIST) regenerative periodontal procedures on pulp vitality. Therefore, the aim of this study was to evaluate the influence of MIST procedures on pulp vitality status in single-rooted and multi-rooted teeth associated to

infraosseous defects extending to the middle and apical thirds.

MATERIALS AND METHOD

This retrospective study analyzed the clinical records of patients who received care between August 2018 and August 2019 at the postgraduate program, Department of Periodontics School of Dentistry, University of Buenos Aires (FOUBA). The study was approved by the FOUBA Ethics Committee by resolution No. 938 (CUDAP: EXP-UBA:0088295). Thirty single-rooted and multi-rooted teeth from 14 patients were included in the study. Patients were 10 women and 4 men, average age 41 ± 17 years, who met the following inclusion criteria: a) systemically healthy patients without contraindications, with at least one tooth treated by regenerative periodontal surgery, b) surgical procedures included Minimally Invasive Surgical Technique (MIST) described by Cortellini and Tonetti in 2007⁷ and Modified Minimally Invasive Surgical Technique (M-MIST) described by the same authors in 2009⁸ and c) teeth were required to have a diagnosis of clinically normal pulp⁹.

Exclusion criteria: smokers, diabetics, pregnant women, presence of grade III furcation lesions and tooth mobility.

Clinical parameters recorded at 180 days post-surgery:

Probing depth (PD) and clinical attachment level (CAL) were recorded using a North Carolina probe (UNC-15, Hu-Friedy, Chicago, IL, USA) at a pressure of 0.3N. Furcation grade was established according to horizontal Hamp classification¹⁰ using a Nabers probe (Q-2N Nabers, Hu-Friedy, Chicago, IL, USA), degree of tooth mobility was classified using the Miller scale¹¹, plaque index per mouth was expressed using the O'Leary index¹², and bleeding on probing (BOP) was assessed dichotomously (presence-absence) following Cortellini et al. 1993a¹³.

Pulp sensitivity to cold was tested using a dichlorodifluoromethane coolant spray (Endo Ice[®], Klepp, Argentina), and periradicular tissue response was tested by percussion and palpation.

Radiographic diagnosis: Periapical X-ray was used to evaluate the chamber (anatomical extension of the chamber, presence of pulp calcifications, caries,

existing restorations, and any sign of previous pulp treatment), degree of root apex development, canal (canal anatomy, presence of calcifications and resorptions), and periradicular tissues (periodontal space and integrity of alveolar cortical plate).

Data analysis:

Statistical analysis of the data from the clinical records was performed using the Statal Package for the Social Sciences software (SPSS). Tooth survival was analyzed by the Kaplan Meier method and the Cox regression model.

RESULTS

Thirty teeth (21 single-rooted and 9 multi-rooted) were included, of which 14 had defects extending to the middle third and 16 had defects extending to the apical third. Twenty-five teeth were treated with MIST technique and 5 with M-MIST technique.

Baseline pulp diagnosis:

Clinical evaluation and x-rays of all 30 teeth were compatible with clinically normal pulp.

Clinical evaluation: Asymptomatic pulp; response to sensitivity test slight and transitory, absence of response to heat, percussion and palpation.

Radiographic evaluation: Chamber, canal and periradicular tissue appearance normal.

Pulp diagnosis 30 days post-surgery:

One tooth presented clinical and radiographic evaluation compatible with acute irreversible pulpitis (Table 1).

Clinical evaluation: Spontaneous, persistent pain of severe intensity in response to temperature changes (cold), and sensitivity to percussion.

Radiographic evaluation: Chamber and canal

appearance normal. Enlargement of periodontal space (Fig. 1a- 1b).

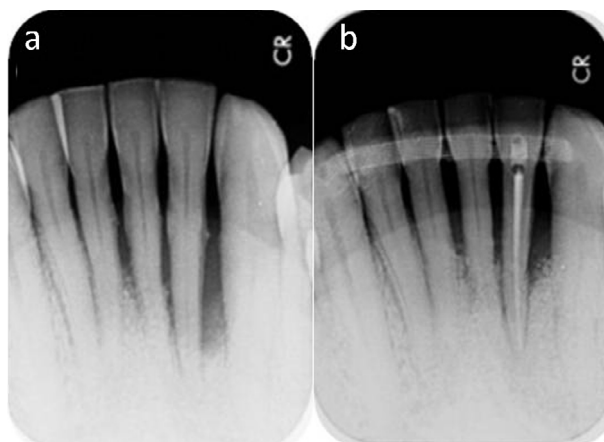


Fig. 1: Periapical radiograph of tooth 32. a) Prior to surgery, chamber and canal appearance normal, intraosseous defect of two walls extending to the apical third distally to the tooth and b) 180 days post-surgery there is adequate filling and slight enlargement of periodontal space.

Pulp diagnosis 180 days post-surgery:

One tooth presented clinical and radiological evaluation compatible with pulp necrosis (Table 1).

Clinical evaluation: Pulp presents no response to sensitivity test.

Radiographic evaluation: radiolucent image circumscribed at the level of the root apex (Fig. 2a-2b).

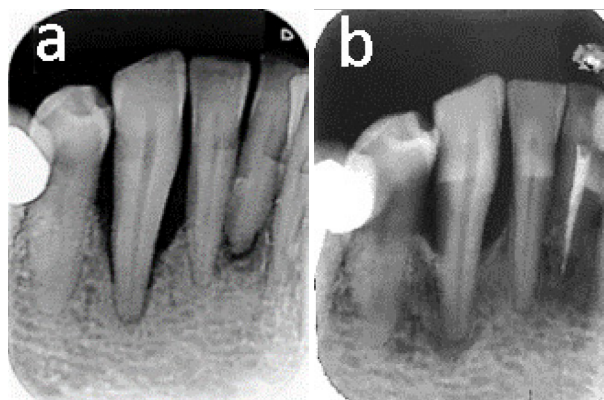


Fig. 2: Periapical radiograph of tooth 43, a) Prior to surgery, chamber and canal appearance normal, intraosseous defect of two walls extending to the apical third mesially and distally, and b) 180 days post-surgery there is a circumscribed radiolucent image at the level of the root apex.

Survival analysis:

The probability of the teeth treated with minimally invasive regenerative periodontal procedures (MIST, M-MIST) to continue having clinically

		N	Percent
Cases available for analysis	Event ^a	2	6.7%
	Censored	0	0.0%
	Total	2	6.7%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	28	93.3%
	Total	28	93.3%
Total		30	100.0%

a. Events: Pulpitis/Necrosis

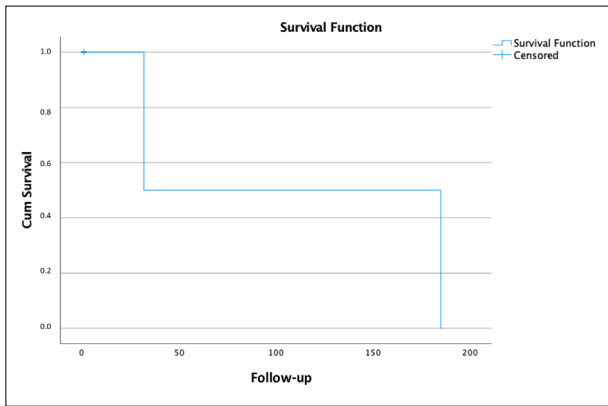


Fig. 3: Graph of survival at 180 days (Kaplan-Meier). Teeth treated by minimally invasive regenerative procedures (blue line). Events (steps).

normal pulp at 180 days post-surgery was 93.3%. For teeth with defects extending to the level of the apical third of the root it was 85.7%, and for teeth with defects extending to the middle third, including presence of furcation lesions, it was 100% (Fig. 3). With a confidence level of 95%, we can say that the mean survival of a tooth treated by minimally invasive regenerative procedures was 105 days with a minimum time of 0 and a maximum time of 252 days.

DISCUSSION

This study evaluated pulp vitality at 180 days post-surgery in 30 teeth treated with MIST. Pulp vitality was determined clinically and radiographically. Pulp sensitivity to cold was tested using a dichlorodifluoromethane coolant spray (Endo Ice), and response of periradicular tissues was tested by percussion and palpation. Pulp sensitivity to cold was used because it is highly precise method for diagnosing necrotic pulps, and more sensitive than the electricity test¹⁴ used in other studies.

Only two out of the 30 teeth presented changes in pulp status following regenerative periodontal procedure. They were both single-rooted and presented bone defects of two walls extending to the apical third, and were treated using MIST. One of them (lower incisor) presented irreversible pulpitis at 30 days, while the other (lower canine) presented necrosis at 180 days post-surgery. The risk rate for changes in pulp vitality was 6.7% (Table 1).

None of the 9 multi-rooted teeth with grade I and II furcation lesions presented changes in pulp status. Indeed, eight of them presented improvement in their horizontal component (Table 2, Fig. 4a-4b).

Table 2. Furcation lesions

Location	Baseline	6 Months
Upper jaw (0/1/II)	(0/1/2)	(1/2/0)
Lower jaw (0/1/II)	(0/1/5)	(4/2/0)

These results agree with the retrospective study published by De Sanctis³ in 2013. Said study evaluated pulp vitality in 137 patients with teeth with defects extending to the apical third, finding no statistically significant association between the number of teeth that lost vitality and the surgical procedures performed. It concluded that

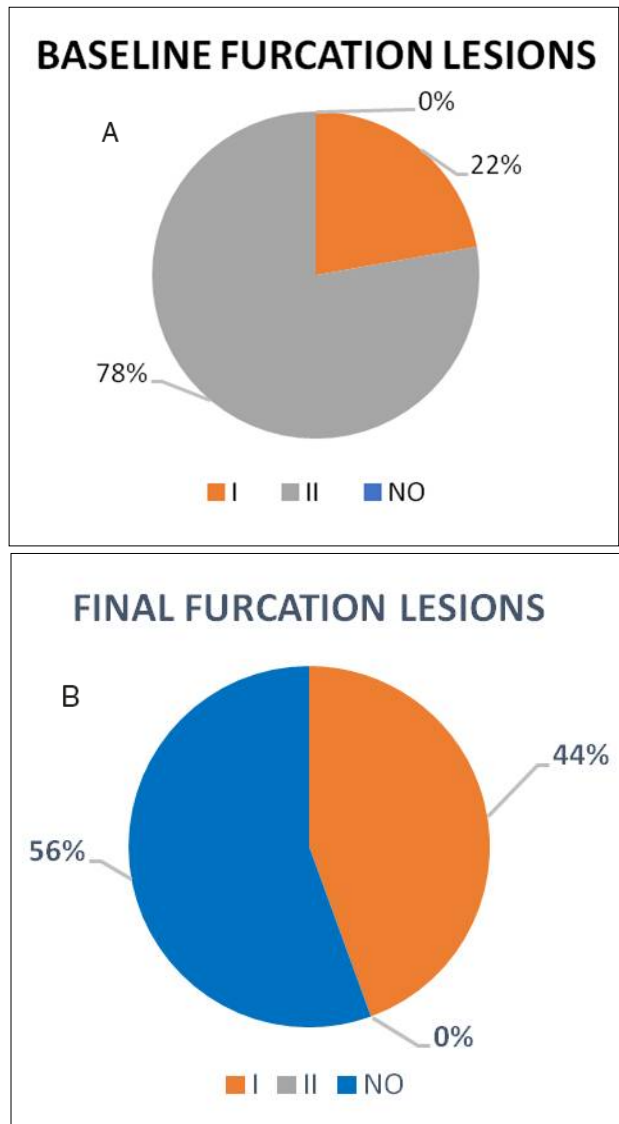


Fig. 4: a) Baseline furcation lesions according to Hamp's classification. 78% had grade II furcation lesions (7 teeth), and the remaining 22% (2 teeth) had grade I furcation lesions. b) Final furcation lesions according to Hamp's classification. 56% present no furcation lesion (5 teeth), and the remaining 44% had grade I furcation lesions (4 teeth).

preventive endodontic treatment is not necessary in compromised teeth that will undergo regenerative surgery.

CONCLUSIONS

Although the number of cases analyzed in this study is small, we can conclude that the probability of single- rooted and multi-rooted teeth treated

by minimally invasive regenerative periodontal procedures (MIST, M-MIST) continuing to have clinically normal pulp at 180 days post-surgery was 93.3%. For teeth with defects extending to the level of the apical third of the root it was 85.7%, and for teeth with defects extending to the middle third, including furcation lesions was 100% (Fig. 3).

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DECLARATION OF CONFLICTING INTERESTS

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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