Revascularization failure of an immature tooth with inflammatory cyst

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ABSTRACT

Aim: To analyze the possible failure causes of a revascularization treatment, including complications derived from the technique and adequate case selection. **Methods:** The following case report describes revascularization failure of a mandibular second premolar with an immature apex, presenting a fistula and a periapical lesion. Irrigation was performed with NaOCl, sterile saline solution and chlorhexidine, and an antibiotic paste comprised by ciprofloxacin, metronidazole and cefaclor was used as an intracanal medicament. Once the fistula disappeared, hemorrhage was induced from the periapex. As there was scant bleeding a blood-soaked collagen sponge was placed into the canal and the cavity access was sealed with MTA. **Results:** After one week the fistula reappeared and periapical surgery was performed, with excision of the lesion. The final diagnosis was of an inflammatory cystic lesion. After 12 months, bone regeneration was complete. **Conclusions:** The failure of this revascularization treatment may be due to the presence of an inflammatory cystic lesion. When proposing this treatment, the size and duration time of the lesion must be taken into account, informing the patient that periapical surgery could be necessary.

Keywords: Endodontics. Regeneration. Root Canal Therapy.

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Introduction

Treatment of an immature tooth with periapical pathology is a challenge for clinicians.[1] The unfavorable crown-to-root ratio, the presence of fine root canal walls and an open apex which is impossible to seal through conventional procedures make this treatment complex and increases the risk of fracture.[2] These cases are conventionally treated via apexification procedures, and although these techniques give considerably predictable results, they do not achieve root strengthening.[3] The ideal treatment would be to accomplish root formation, increasing its length and the dentin width at the walls.[1,4] The recent appearance of regenerative endodontic techniques has made this a real possibility.[1,4-11]

These techniques emerged once it became radiographically and histologically evident that reimplanted permanent teeth with open apices achieved revascularization. The uninfected pulp tissue acts as a scaffold for the growth of new tissue from the periapical lesion.[4] It was hypothesized that if disinfection of necrotic, immature, permanent teeth with apical periodontitis was achieved, the same principles could be taken into account for avulsed, necrotic, immature but uninfected permanent teeth.[12] These techniques are based on the fact that vital stem cells found in the dental papilla and the apical third of the tooth during its formation may survive in cases of necrosis even with the presence of a periapical lesion, due to their proximity to collateral blood circulation[13], having the ability to form dentin and to differentiate into primary odontoblasts.[14]

The American Association of Endodontists has published guidelines to aid the clinician in the selection of cases to be treated satisfactorily with this conservative technique. The candidates for this treatment are permanent teeth with necrotic pulp, with or without periapical pathology, immature apex of 1mm in diameter or larger and a restorable crown;[15,16] in such cases regeneration procedures are the treatment of choice and other less conservative techniques should only be used in case of revascularization failure.[12,17] All these conditions are present in this case report, but since it failed after two months, it required periapical surgery. The aim of this study is to analyze the possible causes of failure, including complications derived from the technique and adequate case selection.

Methods

A 23-year-old Asian woman attended the dental clinic having observed a small lump on her gum for a month. Her medical background showed no history of interest. At the clinical exploration a fistula was observed on the buccal mucosa of the mandibular left second premolar (#3.5). The crown was intact, without caries or restorations, although it seemed to present an imprint of a worn occlusal tubercle (Dens Evaginatus). The contralateral tooth also presented it, although only partially worn (Fig 1). The patient was asymptomatic. When performing pulp vitality tests on #3.5 cold testing gave a negative result (Roeko; Coltene Whaledent, Langenau, Germany), it was also sensitive to percussion and palpation tests and its periodontal probing was normal. Radiographic examination showed incomplete radicular development with an open apex of 1.7mm in diameter and an associated 9.5 x 9mm periapical, unilocular, well defined, radiolucid lesion without radiopaque masses inside (Fig 2). The presumptive diagnosis was compatible with radicular cyst, apical granuloma or apical abscess.

Various treatment options were assessed and as the case met the requirements established by Wigler et al.,[15] it was decided to perform a pulp revascularization procedure. Even so, prognosis for #3.5 was reserved due to: 1) patient's age; 2) long-term pulp necrosis; 3) immature root with open apex; 4) poor crown-to-root ratio; and 5) large radiolucid lesion. The patient was informed of the treatment and accepted the implementation of the procedure by signing an informed consent form.

The access cavity of #3.5 was performed under local anesthesia with 2% Lidocaine 1:100.000 and absolute isolation with rubber dam. No bleeding or tissue remnants were observed. The coronal portion of the canal was copiously irrigated with 30 ml of 2,5% sodium hypochlorite (NaOCl), 10 ml of sterile saline solution and 10 ml of 0,12% chlorhexidine.[1] Manual instrumentation was performed with a #30 K-file (Dentsply Maillefer, Ballaigues, Switzerland).

The canal was dried with paper points and it was filled with the triple antibiotic paste consisting of ciprofloxacin, metronidazole and cefaclor, prepared at the pharmacy with propylene glycol.[18] The access cavity was sealed with a sterile cotton pellet and shade A5 composite (Estelite Quick, Tokuyama Dental Corporation, Tokyo, Japan).

The patient was assessed one month later and referred no symptomatology. There was no sensitivity to

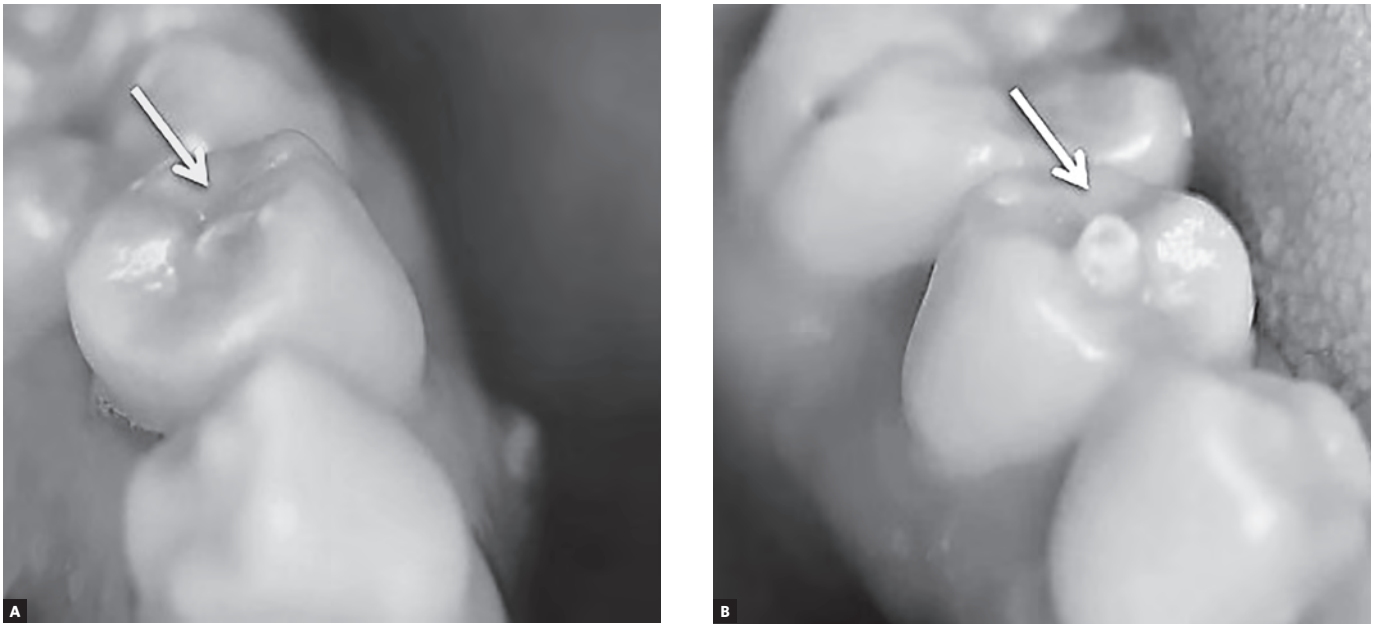

Figure 1. A) Photograph showing the sinus tract and worn occlusal tubercle of #3.5, without the presence of any caries. The worn occlusal tubercle might be the cause of the pulp necrosis and subsequent pulp microexposure **B**) Image of the contralateral tooth (#4.5) with the presence of a partially worn occlusal tubercle (Dens Evaginatus).

Figure 2. A) Periapical radiography of tooth #3.5 where it can be seen its incomplete radicular development, a poor crown-root ratio, open apex and radiolucid periapical lesion without radiopaque masses inside. **B**) Periapical radiography of #3.5 after the revascularization procedure.

percussion or palpation and the fistula had disappeared. 3% mepivacaine without epinephrine was used as an anesthetic to aid in the appearance of hemorrhage,[8,19] the composite was removed and so was the triple antibiotic paste by irrigating with 20 ml of 2,5% NaOCl. After drying and establishing there was no exudate, hemorrhage was induced from the periapex with a #30 manual K-file (Dentsply Maillefer, Ballaigues, Switzerland). Bleeding was not observed at the orifice of the canal, therefore a collagen sponge (Octocolagen©) was inserted into the canal so it could act as a stable scaffold.[20] After 15 minutes MTA (Angelus Soluçöes Odontológicas, Londrina, Brazil) was placed. The access cavity was then sealed with a damp cotton pellet and a temporary filling material (Cavit™, 3M ESPE AG. Dental Products, Seefeld, Germany)[1] (Fig 2).

Results

When the patient returned a week later to place a permanent filling material, although she still referred no symptomatology, the fistula had reappeared. In light of this revascularization failure, the various treatment options to be followed were assessed: extraction or periapical surgery with exeresis-biopsy of the lesion. The latter was chosen and subsequently performed.

The surgical intervention was performed under 4% articaine 1:100.000. An intrasulcular incision was made from #3.3 to 3.6, with a vertical incision distal to #3.6, using a cold scalpel with a 15C blade. Once the mucoperiosteal flap was elevated, the loss of external cortical bone was observed at the level of #3.4 (Fig 3). Minor ostectomy was performed under constant irrigation with a hand piece and a number 8 tungsten carbide round bur to improve access to the periapical lesion and facilitate its exeresis. The lesion was removed with a mosquito forceps and a spoon excavator. At this moment a purulent exudate came out of the lesion. Once the lesion was completely removed, curettage of the operatory area was performed under copious irrigation with physiological saline solution. Finally, an apicectomy was performed using a hand piece and a number 6 round carbide tungsten bur, attempting to be conservative during the apical resection. A retrograde cavity was prepared using a conventional diamond-coated ultrasonic tip for apical surgery (Piezon Master 400; EMS Electro Medical Systems SA, Nyon, Switzerland) and it was filled with MTA. The mucoperiosteal flap was replaced and sutured with absorbable suture (Vicryl rapide, Ethicon). The obtained specimen was stored in a 10% formaldehyde solution and it was sent for anatomopathological study (Fig 3). The result was: periapical cyst with severe inflammatory changes. After two weeks no clinical signs or symptoms of infection were observed and a permanent composite restoration was placed. Check-ups after 1, 3 and 6 months were made and bone regeneration was observed. After 12 months the patient began orthodontic treatment (Fig 4).

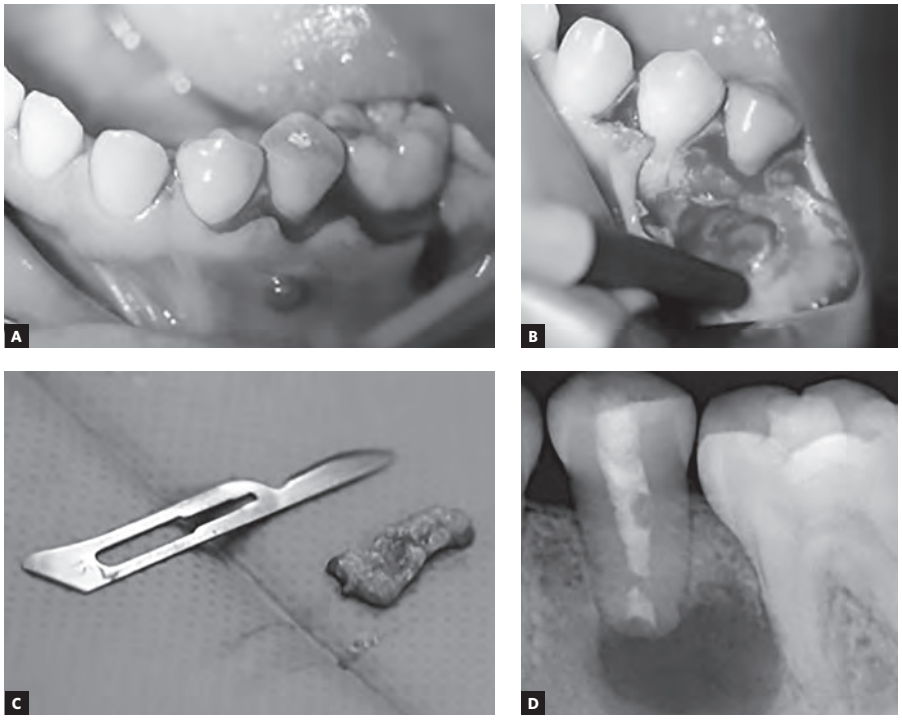

Figure 3. A) Intrasulcular incision was made from #3.3 to #3.6. It can be seen the temporary coronal filling and the fistula that had reappeared apical to #3.5. **B**) Visible loss of the external cortical bone located at #3.5. **C**) Image of the removed lesion before being sent for anatomopathological study. **D**) Periapical radiography of #3.5 just after the surgery.

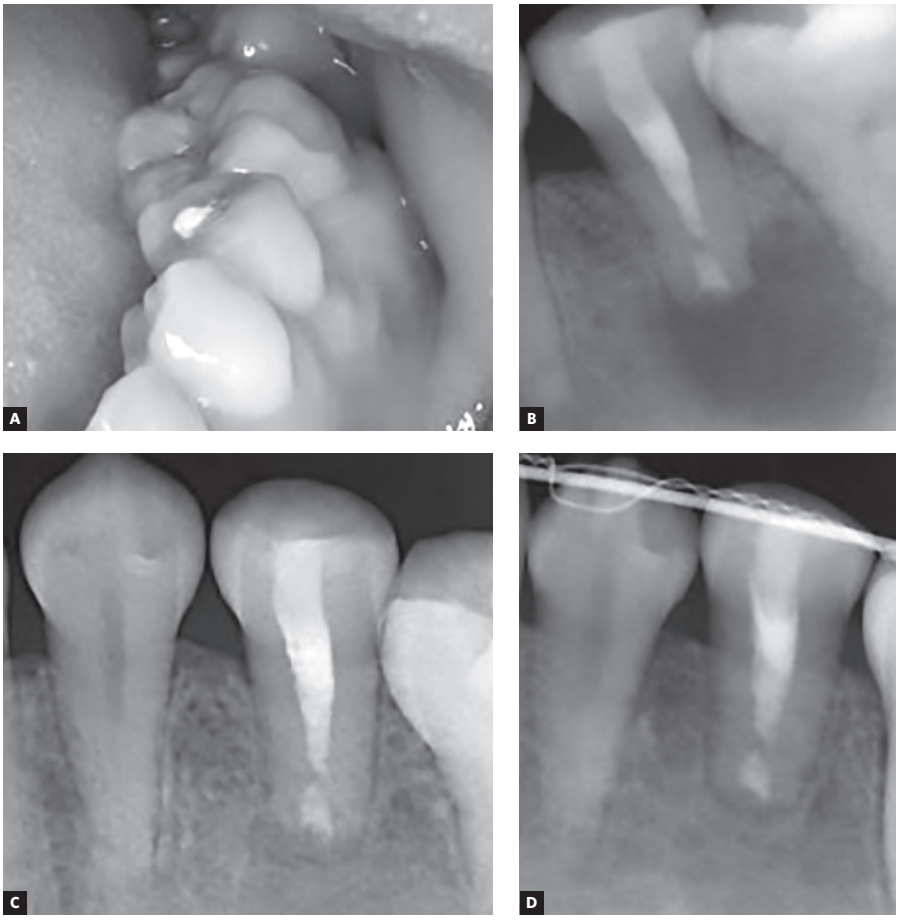

Figure 4. A) Photograph 15 days after the surgery where no signs of the fistula can be seen. **B**) Radiograph of #3.5 after the final coronal filling. **C**) Periapical radiography of #3.5 six months after the periapical surgery and removal of the periapical cyst. **D**) Periapical radiography of #3.5 twelve months later. The patient had begun the orthodontic treatment.

Discussion

Traditionally, a necrotic tooth with an open apex has been treated through apexification. The attempt to use revascularization procedures in the case presented is due to the improved results this technique has shown even in cases of periapical pathology.[1,4] In this case, revascularization treatment failed[21] as the fistula reappeared within two months. This could be due to mistakes in the development of the revascularization procedure or because of an inadequate tooth selection.

When analyzing the technique, all its steps must be taken into account. A combination of NaOCl with clorhexidine was used as irrigation,[1,11] using sterile saline in between to minimize possible interactions.[22] Disinfection was completed with a modification of the triple antibiotic paste described by Hoshino et al.,[23] of already proven effectiveness.[18] Minocycline was excluded to avoid potential discoloration.[14] This paste was left in the canal for a month, after which the fistula disappeared. In light of the absence of clinical signs and symptoms and the possibility of drying the canal after removing the antibiotic paste, the disinfection procedure was deemed satisfactory.

When inducing blood clot formation, there was no copious bleeding, therefore a blood-soaked collagen sponge was placed.[20,24] If the absence of a stable blood clot in a correctly disinfected canal were responsible for treatment failure, in time, a barrier of hard tissue would have been formed between the apex and the MTA.[14] However, the fistula reappeared after one week, which can't be associated to the blood clot loss. It is probable the canal became reinfected

whilst producing hemorrhage, possibly when pricking the cyst with a file, or because of a poor access cavity seal since a temporary filling material was used over the MTA.

In the present case, part of the MTA was extruded to the apical third of the root, similarly to Jung et al.[20] and Petrino et al.,[7] not being a relevant circumstance in these cases for the root to continue its development. The apical MTA displacement must, however, be taken into account as it could have interfered in the depths of the newly formed tissue.[25]

Another possible cause of failure could be an inadequate case selection. The age of this patient (23 years) should be considered since the average age of patients with lower second premolars satisfactorily treated through a revascularization technique is 11.3 years.[1,4,20] Although it is true that younger patients (8 to 13-year-olds) have a greater healing capacity,[12] there have been published cases of older people (16, 17 and 24-year-olds) with favorable results.[6,26]

Regarding the pulp condition, the factor that seems to be associated with the survival of these cells and their ability to differentiate is the duration of infection. In long-term infections, the likelihood of cell survival is low, and the penetration of bacterial colonies into dentinal tubules is higher, causing difficulties for disinfection.[13] The present case is possibly a long-term infection going back 10 years.

Furthermore, the presence of a cyst will compromise the root canal treatment's outcome of the affected tooth.[27] Hepworth and Friedman[28] observed that endodontic retreatment of teeth affected by cystic lesions was a success in 66% of cases, whilst surgical treatment by means of lesion elimination was successful in 95% of cases. Considering the indications for performing periapical surgery by the Sociedad Española de Cirugía Bucal,[29] any radiolucent lesion with a diameter greater than 8-10 mm must be treated with periapical surgery. In this case, the lesion was 9.5 mm in diameter. The size of the lesion should be another factor to take into account when considering a revascularization treatment.

There are few published cases listed as failures. Ding et al.[6] considered 6 treatments as failures due to not being able to obtain a blood clot or because of the appearance of pain after applying the antibiotic paste. Lenzi and Trope[25] obtained an auto-apexification, most likely because the blood clot ruptured leaving an empty space where new tissue was formed. Chen et al.[14] described 2 cases in which a barrier of hard tissue was formed between the MTA and the root apex, with healing of the periapical lesion. Yadav and cols.[30] observed a 17-year-old patient in which revascularization treatment had failed as the radiolucent area and symptoms still remained two years after treatment. This was possibly due to an inadequate biofilm removal, since healing was posteriorly achieved by disinfecting with calcium hydroxide and placing an FRP matrix with MTA as an apical stop.

Conclusions

The failure of this revascularization treatment is likely to be due to an inadequate case selection. Although the infection was controled in the first moment, the canal was reinfected whilst producing hemorrhage, possibly when pricking the cyst with a file. The presence of an inflammatory cystic lesion of this size, inevitably required periapical surgery. However, as it is not possible to diagnose a cyst using radiographs alone, a revascularization treatment can't be ruled out. When proposing this treatment, the size and duration time of the lesion must be taken into account, informing the patient that periapical surgery could be necessary.

References

1. Banchs F, Trope M. Revascularization of immature permanent teeth with apical periodontitis: new treatment protocol? J Endod. 2004 Apr;30(4):196-200.
2. Abbott P. Apexification with calcium hydroxide: when should the dressing be changed? The case for regular dressing changes. Aust Endod J. 1998 Apr;24(1):27-32.
3. Andreasen JO, Farik B, Munksgaard EC. Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture. Dent Traumatol. 2002 June;18(3):134-7.
4. Iwaya SI, Ikawa M, Kubota M. Revascularization of an immature permanent tooth with apical periodontitis and sinus tract. Dent Traumatol. 2001 Aug;17(4):185-7.
5. Shah N, Logani A, Bhaskar U, Aggarwal V. Efficacy of revascularization to induce apexification/apexogensis in infected, nonvital, immature teeth: a pilot clinical study. J Endod. 2008 Aug;34(8):919-25; Discussion 1157.
6. Ding RY, Cheung GS, Chen J, Yin XZ, Wang QQ, Zhang CF. Pulp revascularization of immature teeth with apical periodontitis: a clinical study. J Endod. 2009 May;35(5):745-9.
7. Petrino JA, Boda KK, Shambarger S, Bowles WR, McClanahan SB. Challenges in regenerative endodontics: a case series. J Endod. 2010 Mar;36(3):536-41.
8. Dhillon H, Kaushik M, Sharma R. Regenerative endodontics: creating new horizons. J Biomed Mater Res B Appl Biomater. 2016 May;104(4):676-85.
9. El Ashiry EA, Farsi NM, Abuzeid ST, El Ashiry MM, Bahammam HA. Dental pulp revascularization of necrotic permanent teeth with immature apices. J Clin Pediatr Dent. 2016;40(5):361-6.
10. McCabe P. Revascularization of an immature tooth with apical periodontitis using a single visit protocol: a case report. Int Endod J. 2015 May;48(5):484-97.
11. Pini NIP, Nagata JY, Sundfeld-Neto, D et al. Reestablishing biology, function, and esthetics for fractured, maturity-compromised incisors. Oper Dent. 2015;40:341-9.
12. Neha K, Kansal R, Garg P, Joshi R, Garg D, Grover HS. Management of immature teeth by dentin-pulp regeneration: a recent approach. Med Oral Patol Oral Cir Bucal. 2011 Nov 1;16(7):e997-1004.
13. Huang GT. A paradigm shift in endodontic management of immature teeth: conservation of stem cells for regeneration. J Dent. 2008 June;36(6):379-86.
14. Chen MY, Chen KL, Chen CA, Tayebaty F, Rosenberg PA, Lin LM. Responses of immature permanent teeth with infected necrotic pulp tissue and apical periodontitis/abscess to revascularization procedures. Int Endod J. 2012 Mar;45(3):294-305.
15. Wigler R, Kaufman AY, Lin S, Steinbock N, Hazan-Molina H, Torneck CD. Revascularization: a treatment for permanent teeth with necrotic pulp and incomplete root development. J Endod. 2013 Mar;39(3):319-26.
16. AAE Clinical Considerations for a Regenerative Procedure. Revised 6-8-16. 2016 [Access in: 2017 Feb 20]. Available from: www.aae.org.
17. Bukhari S, Kohli MR, Setzer F, Karabucak B. Outcome of revascularization procedure: a retrospective case series. J Endod. 2016 Dec;42(12):1752-1759.
18. Windley W 3rd, Teixeira F, Levin L, Sigurdsson A, Trope M. Disinfection of immature teeth with a triple antibiotic paste. J Endod. 2005 June;31(6):439-43.
19. Cehreli ZC, Isbitiren B, Sara S, Erbas G. Regenerative endodontic treatment (revascularization) of immature necrotic molars medicated with calcium hydroxide: a case series. J Endod. 2011 Sept;37(9):1327-30.
20. Jung IY, Lee SJ, Hargreaves KM. Biologically based treatment of immature permanent teeth with pulpal necrosis: a case series. J Endod. 2008 July;34(7):876-87.
21. Moreno-Hidalgo MC, Caleza-Jimenez C, Mendoza-Mendoza A, Iglesias-Linares A. Revascularization of immature permanent teeth with apical periodontitis. Int Endod J. 2014;47:321-31.
22. Zehnder M, Schmidlin P, Sener B, Waltimo T. Chelation in root canal therapy reconsidered. J Endod. 2005 Nov;31(11):817-20.
23. Hoshino E, Kurihara-Ando N, Sato I, Uematsu H, Sato M, Kota K, et al. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. Int Endod J. 1996 Mar;29(2):125-30.
24. Yang J, Zhao Y, Qin M, Ge L. Pulp revascularization of immature dens invaginatus with periapical periodontitis. J Endod. 2013 Feb;39(2):288-92
25. Lenzi R, Trope M. Revitalization procedures in two traumatized incisors with different biological outcomes. J Endod. 2012 Mar;38(3):411-4.
26. Aggarwal V, Miglani S, Singla M. Conventional apexification and revascularization induced maturogenesis of two non-vital, immature teeth in same patient: 24 months follow up of a case. J Conserv Dent. 2012 Jan-Mar;15(1):68-72.
27. Nair PN. New perspectives on radicular cysts: do they heal? Int Endod J. 1998 May;31(3):155-60.
28. Hepworth MJ, Friedman S. Treatment outcome of surgical and non-surgical management of endodontics failures. J Can Dent Assoc. 1997 May;63(5):364-71.
29. Peñarrocha M. Protocolo en cirugía endodóntica. Barcelona: Sociedad Española de Cirugía Bucal; 2001.
30. Yadav P, Pruthi PJ, Naval RR, Talwar S, Verma M. Novel use of platelet-rich fibrin matrix and MTA as an apical barrier in the management of a failed revascularization case. Dent Traumatol. 2015 Aug;31(4):328-31.