Post natal mesenchymal cells possibility to regenerate and repair dental structures.

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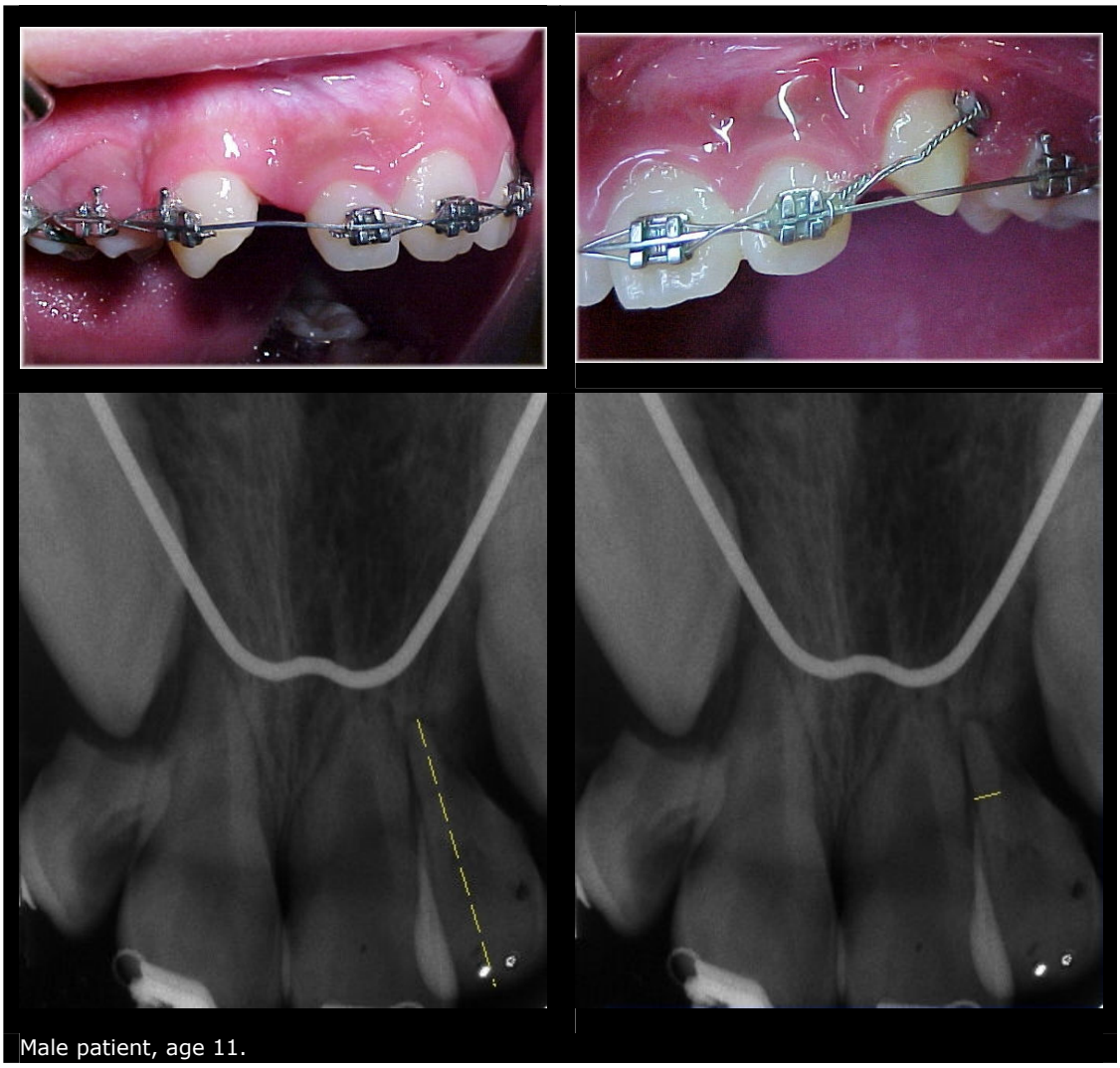
Endodontic management of immature permanent teeth with necrotic pulps and open apices is a significant challenge, owing to the presence of thin dentin walls and the lack of a natural apical constriction that an obturation material can be placed against (Al Ansary et al 2009) (Mente et al 2009). For decades, such teeth have been treated by the apexification procedure, which involves placement of intracanal calcium hydroxide ($Ca(OH)_2$) to induce formation of a calcific barrier at the apex. Recently, the traditional apexification procedure has been modified by the introduction of artificial apical barrier methods with mineral trioxide aggregate (MTA) (Witherspoon et al 2008). Although this might considerably shorten the treatment period, and result in favorable healing of the periapical tissues (Sarris et al 2008) (Cehereli et al 2011) it still cannot stimulate the development of apical closure and thickening of radicular dentin. Regenerative endodontic methods have the potential to allow for continuation of root development and might therefore offer an alternative therapeutic approach in the management of immature permanent teeth with compromised structural integrity (Murray et al 2007). Iwaya et al (2001) showed that continued root development and apical closure in a necrotic immature tooth were possible when successful disinfection of the root canal was achieved. Later, Banchs and Trope (2004) described a new treatment protocol termed *revascularization* for the management of immature permanent teeth with apical periodontitis. The first step of this regenerative technique involves disinfection of the root canal with copious sodium hypochlorite (NaOCl) irrigation and a combination of ciprofloxacin, metronidazole, and minocycline. After disinfection, the antibiotic paste is removed, and apical bleeding is induced into the canal to produce a blood clot. As a final step, the canal orifice is sealed with MTA, and a permanent coronal restoration is placed. Since the description of the revascularization technique, several case reports and treatment outcome studies have demonstrated the regenerative potential of this treatment protocol, as evidenced by increased root length, thickening of the root wall, and apical closure to varying degrees. (Bose et al 2009)

Patients

Two patients a boy and a girl (11-7 years of age) were referred to the orthodontic clinic for endodontic and restorative management of immature permanent incisors. The teeth included the lateral supper incisors right and left and right lateral and right maxillary lateral incisor. The clinical examination, the teeth presented pulp necrosis diagnosis. None of the teeth responded to cold test or electric pulp test. Signs of sinus tracts were observed in the buccal mucosa in the famele lateral incisor.

Radiographic examination of the teeth showed immature roots with open apices with very short root development. Taking into consideration the incomplete root development with wide-open apices, regenerative endodontic treatment was considered.

After, consent of the patients and parents was obtained, and the treatment was initiated at the same visit.



Male patient, age 11.

Female patient, age 7.

Revascularization Protocol

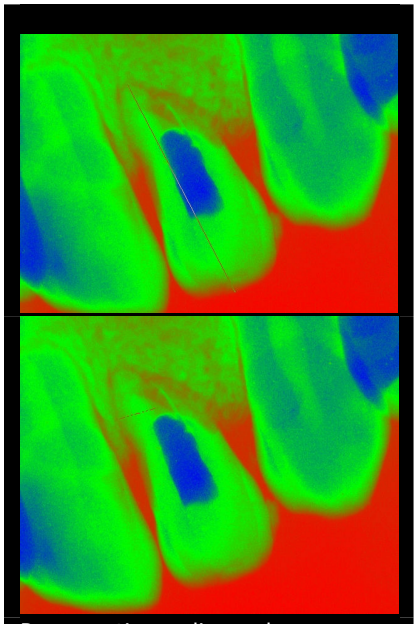
All teeth were treated by a common, 2-visit regenerative endodontic protocol. On initial visit, the pulp chamber was accessed after anesthesia and rubber dam isolation. Each root canal orifice was gently irrigated with 10 mL of 5 % NaOCl without any instrumentation. After irrigation, $Ca(OH)_2$ powder (Merck, Darmstadt, Germany) was mixed with yodoform and sterile water to produce a thick, homogeneous paste. The mixture was placed in the pulp chamber with a plastic carrier and was loosely packed into the coronal portion of the root canals with moist cotton pellets. The access cavity was sealed with Cavit (3M Espe, St Paul, MN), and the patients were recalled 2 weeks later.

At the second visit, all teeth were asymptomatic and showed radiographic evidence of reduction in periapical radiolucency. The teeth were anesthetized, isolated with a rubber dam, and reaccessed. In each root canal, the was removed with copious 5% NaOCl irrigation, and thereafter, the root canals received a final irrigation with 10 mL sterile saline and were dried. Apical bleeding was induced by gentle irritation with #15 K-files. cementoenamel junction was achieved. After formation of the blood clot, MTA (Dentsply Tulsa Dental, Tulsa, OK) was prepared according to the manufacturer's instructions and was gently adapted over the blood clot. Finally, a wet cotton pellet was placed over the MTA, and the access cavity was temporarily restored with conventional glass ionomer cement. The final coronal restorations were placed 3–4 weeks later.

Image Registration and Analysis

Preoperative and final recall radiographs were converted to 32-bit TIFF files by using UTHSCSA Image Tool. Version 3.0 and the Palette Files and Analysing –distance tool the root lengths and root wall thicknesses were measured.

At 24 months, all teeth were asymptomatic and showed complete radiographic healing of periradicular radiolucencies. Radiographic examination showed a visible increase in the root dimensions.
The extent of increase in the root wall thickness and root length is presented in graphic 4.



Preoperative radiographs

24 months recall, female patient

24 months recall, male patient

PD	PREOPERATIVE			24 MONTHS RECALL			% INCREASE		
	LENGHT	M	D	LENGTH	M	D	LENGHT	M	D
22	15,3	1,2	1,06	33,51	5,27	4,19	22,21	4,07	3,13
12	11,14	2,31	1,73	27,15	3,49	1,73	11,14	1,18	0
22	20,55	1,46	1,11	25,33	2,07	1,8	4,78	1,61	0,79

Graphic 1

Discussion

Case reports and series still constitute a considerable amount of the published literature on regenerative endodontic procedures. In today's increasing demand for higher levels of evidence, case reports might possess relatively minor impact in determining the efficacy of a given treatment modality. Nonetheless, well-documented case reports can make meaningful contributions in identifying potentially important parameters that can guide the design of future prospective clinical trials. (Pierson 2009) (Petrino et al2010)

In this study including 3 teeth, one immature maxillary lateral incisor with previously initiated therapy and chronic apical abscess was treated with the revascularization protocol by using coronally packed $Ca(OH)_2$ and yodoform paste. 24 months after the initial treatment, the tooth showed radiographic evidence of advanced root development and periradicular healing. Compared with those 3 cases, the present 3 lateral incisor showed similar patterns of periradicular healing and continued root development, which substantiate the findings of Bose et al (2009) that placement of $Ca(OH)_2$ in the coronal half of the root canal can contribute to a significant increase in root length and root wall thickness. In the retrospective study of Chueh et al (2009), $Ca(OH)_2$-medicated teeth showed a high rate (91%) of partial obliteration of the root canal, suggesting that the pattern of root development induced by regenerative endodontic treatment might be different from that of physiologic maturogenesis. Radiographic evidence of root canal obliteration to varying degrees can also be observed in previous reports utilizing double and triple antibiotic formulations .Obtaining standardized radiographic series from a tooth might be a significant challenge, particularly in the child patient. Recently, Bose et al (2009) described an image correction technique to transform nonstandardized preoperative and postoperative radiographs into mathematically aligned radiographic images. The calibrated output files permitted the investigators to measure the magnitude of changes in the root dimensions and calculate the estimates of radiographic success in regenerative endodontic procedures. Finally, because each case is normalized to its own preoperative (or postoperative) measurement, the potential source of systematic errors is minimized.

According to Torabinejad and Turman (2011) both the coronal level of regenerated tissue and the thickness of filling materials placed over this tissue affect the presence or absence of responses to EPT and cold. The authors reported positive responses to both EPT and cold in an immature maxillary premolar with a coronal MTA plug placed close to the cementoenamel level.

Long-term prospective studies are required to confirm these findings.

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