Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 15847 - 15852
Received 05 March 2021; Accepted 01 April 2021.

An Analysis of Management of Immature Non Vital Teeth - A Retrospective Study

Running Title: Endodontic management of immature non vital teeth

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Abstract
Introduction: Endodontic management of immature non vital teeth permanent teeth in young patients is a great challenge to dentists. The walls of the root canal are frequently divergent and open apexes make debridement and obturation difficult. Closure of root apex is very essential for the success of endodontic treatment.
Aim : To analyse the different methods which were used for the management of immature teeth.
Material and methods: Retrospective study was done with the data collected from DIAS. Data like age, sex, teeth type and materials were collected from the dental records of the patient who reported for the management of open apex, Statistical analysis of the obtained data was with SPSS.
Results: A total of 34 cases were reported for the management of open apex. 4 parameters were checked – age, sex, teeth, material. Apexification was done in 23 cases and revascularization in 11 cases.
Conclusion: Apexification was the preferred choice of treatment for the management of open apex cases by many clinicians.Revascularisation induced maturogenesis – can provide several advantages over apexification.

Key words – Apexification , Apex formation, maturogenesis, revascularisation, MTA

Introduction

Numerous reasons exist for early stage pulp necrosis development in immature permanent teeth(Ramamoorthi, Nivedhitha and Divyanand, 2015; Nandakumar and Nasim, 2018). Such reasons include dental caries, trauma, and dental structure abnormalities(Rajakeerthi and Ms, 2019; Jose, P. and Subbaiyan, 2020). Bacterial infection of dental pulp in immature permanent teeth with open apices poses numerous challenges to the dentist. Traditionally, the treatment of immature teeth with necrotic pulp involve long term application of calcium hydroxide to induce apexification at the root apex .(Rafter, 2005) Decomposed pulp tissue and bacteria in teeth resulting in pulp necrosis can cause acute to chronic inflamed periapical tissue around the apical foramen(Janani, Palanivelu and Sandhya, 2020).

Because of the following reasons, substantial challenges are encountered in the treatment of teeth with immature roots (Thibodeau and Trope, 2007).

1. Thin dentinal wall, the pulp canal is thin.
2. Wide open apex- Apical foramen is not closed and attaining a favourable apical closure with traditional endodontic treatment is difficult.

Patients are relatively young when dental problems occur and they are nervous , frightened and impatient during treatment. The traditional method for treating pulp necrosis in teeth where the tooth is immature is apexification. Teeth with immature roots have an abundant blood supply, and the surrounding undifferentiated stem cells possess excellent healing potential.

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Regenerative endodontic method involves the root to continue regeneration in width and length to even recover the vitality of the pulp(Hargreaves *et al.*, 2008)(Iwaya, Ikawa and Kubota, 2001)(Andreasen, Farik and Munksgaard, 2002). Revascularization is the proven therapy in the treatment of immature, necrotic teeth and which needs three pivotal components like signaling molecules, stem cells, and a physical scaffold for its success. Different authors have used various scaffolds like natural blood clot, platelet-rich plasma or platelet-rich fibrin for a revascularization procedure(Shivashankar *et al.*, 2017). However, these physical scaffolds are found with various pitfalls and contradictory issues(Nagaveni *et al.*, 2019).In few cases, successful revascularization has occurred without initiating the blood clot inside the root canal.
Several cases of reports on endodontic regeneration including immature permanent tooth with pulpal necrosis have been recently published(Banchs and Trope, 2004)(Baer *et al.*, 2013)(Baer *et al.*, 2013; Wu *et al.*, 2014)(Reynolds, Johnson and Cohenca, 2009)(Seraj, 2018)(Jung, Lee and Hargreaves, 2008)(Shah *et al.*, 2008)(Ding *et al.*, 2009; Rajendran *et al.*, 2019). Aim of this study is to analyse the different methods which were used for the management of immature teeth.

Materials and Methods

This retrospective study was carried out at Department Of Conservative Dentistry And Endodontic, Saveetha dental college and hospitals, Chennai. As this study was entirely based on data collection from existing dental records available in DIAS (Dental Information Archiving Software) Saveetha Dental College, ethical clearance was not obtained.
Dental records of the patients who have undergone the treatment for open apex/immature teeth from June 2019 to March 2020 were retrospectively examined by a single examiner. Data was broadly divided into 2 categories – Apexification and revascularization.Only those who had treatment completed by the same endodontist in the endodontic specialty clinic were included for the study.Data were collected from 30 cases recorded. Following data were collected from patient record:- age, sex, teeth in which treatment was done, method for management , total no of cases reported with open apex, material used for apexification, scaffold used.
Data was tabulated in the excel sheet and statistical analysis was done using SPSS 21.0 version. Descriptive analysis of the data was done (mean and standard deviation) and chi square test was done to check the association between age and apexification, gender and apexification etc with a level of significance set at 0.05 (T values < 0.05). Total of 34 cases were examined. 4 different parameters were checked – age, sex, teeth type, scaffold and material. Maximum no of cases with open apex were male (74%) belonging to the age group of 18 to 30 years. (84%). Minimum no of cases with open apex were females belonging to the age group of 31 to 40 years (12 %). A total of 85% of cases were upper anterior and 6% of cases were upper lateral. Out of 11 cases of revascularization, 21% cases have used scaffold (Concentrated growth factor) 79% of cases did not use any scaffold. Out of 23 cases of apexification, 93% of cases had used MTA and 3% of cases had used Biodentine as an apical plug material.
When apexification and Gender was correlated was significant (P Value less than 0.05). When Revascularization and gender was correlated the association was not significant (P value greater than 0.05). Association between apexification in different age groups was significant. Association between apexification and gender was also significant.

Figure 1-Association between Apexification and Age

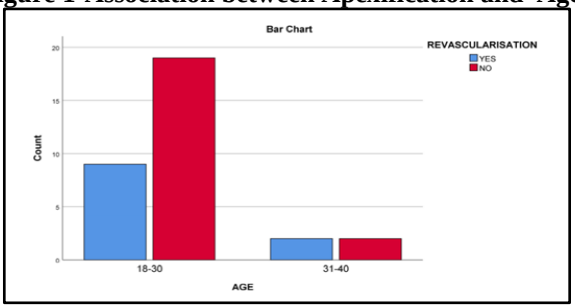

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Figure 2- Association between Gender and Apexification

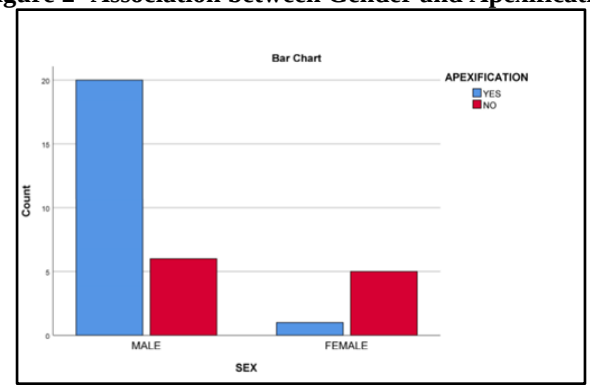
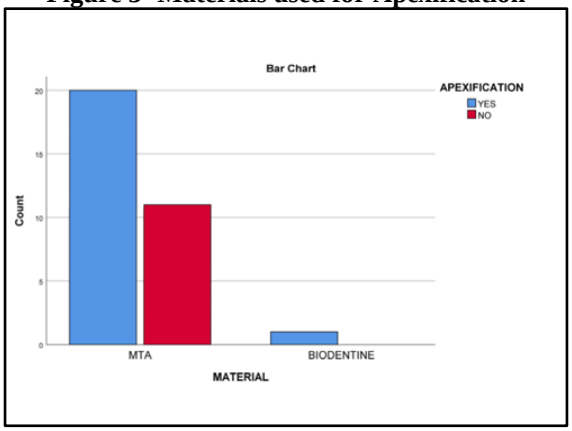


Figure 3- Materials used for Apexification



Discussion

Recent advances in the field of regenerative medicine have led to the paradigm shift in the restoration for tissues affected by disease, trauma, cancer or congenital deformity(Murray, Garcia-Godoy and Hargreaves, 2007; Kumar and Ajitha, 2019; Rajakeerthi and Ms, 2019). These have inspired the dental researchers to look beyond just replacement of damaged tissues and the researchers are now trying to develop methods to regenerate them, rather than just replacing (Nasim *et al.*, 2018).

Conventional endodontic treatment of immature roots with necrotic pulp and apical periodontitis pose multiple challenges.(Ramanathan and Solete, 2015; Teja and Ramesh, 2019) These challenges include disinfection of the root canal with standard protocols that aggressively use endodontic files, filling the root canal with an open apex that provides no barrier for stopping the root filling material before impinging on the periodontal tissues, and the susceptibility of the teeth to fracture because of their thin roots(Ramamoorthi, Nivedhitha and Divyanand, 2015; Ramanathan and Solete, 2015). So a very light filing or no filing is performed with copious irrigation with 0.5% sodium hypochlorite. A lower strength of sodium hypochlorite is used because of the danger of its extrusion beyond the apex of immature teeth.(Ravinthar and Others, 2018; Siddique *et al.*, 2019) The lower strength of sodium hypochlorite is compensated by the volume of the irrigant used. An irrigation needle that can passively reach close to the apical length is useful in disinfecting the canals of immature teeth. The intracanal medication is placed when the irrigant leaving the canal is clean of debris.(Noor and Others, 2016; Manohar and Sharma, 2018; Siddique *et al.*, 2019)

Traditionally, the only regenerative therapy which was available was apexification using long term calcium hydroxide therapy(Frank, 1966). Hiethersay et al (Andersson *et al.*, 2012) stopped using CMCP because of its toxic effects and used only calcium hydroxide to treat necrotic immature teeth. Since then various clinical studies had demonstrated the effects of calcium hydroxide in apexification.(Kleier and Barr, 1991)(Andreasen, Farik and Munksgaard, 2002)(Cvek, 1992)

Apical plug of MTA is currently the clinicians choice and it has several advantages over calcium hydroxide induced apexification(Simon *et al.*, 2007). MTA is a biocompatible material that has osteoinductive properties, set in the

presence of moisture, the treatment can be finished in a single sitting.
However, it does not strengthen the remaining tooth structure(Kumar and Antony, 2018). In contrast, Revascularisation overcomes all these drawbacks. It reinforces the remaining tooth structure by promoting the root growth. Vital mature adult pulp stem cells remain at the apical end of the root canal and cause pulp revitalization(Heithersay, 1975). and the revascularization of pulp occurs because of multipotent dental pulp stem cells(Heithersay, 1975; Gronthos *et al.*, 2002) or stem cells from the bone marrow released by overinstrumentation(Shabahang *et al.*, 1999; Teja, Ramesh and Priya, 2018).
Moreover, open apex provides a channel for stem cells residing in the apical papilla and new blood vessels to proliferate into the pulp space over the blood clot matrix. Blood clot plays an important role in regeneration by releasing various growth factors like PDGF, VEGF etc.(Wang *et al.*, 2007)
However, one cannot rely on these factors, as the concentration of the factors in these fibrin clots are unpredictable might vary with age, gender, size of apical opening etc.

Conclusion

Within the limitation of the study, it can be concluded that apexification was the preferred choice of treatment for the management of open apex cases by many clinicians. Revascularisation induced maturogenesis can provide several advantages over apexification procedures. However a detailed histopathological study is necessary to demonstrate the actual content of pulp space. MTA was used in many cases owing to its advantages like single visit apexification, osteoinductive properties.

Acknowledgement

With sincere gratitude, we acknowledge the staff members of the department of Conservative Dentistry and Endodontics, Saveetha Dental College and study participants for their extended support towards the completion of research.

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Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 15847 - 15852
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