Sequelae of dental trauma and the importance of correct diagnosis

Thikrayat Bani-Hani[1], Rona Leith[2], & Anne C. O'Connell[2]
[1]Jordan University of Science and Technology
[2]Dublin Dental University Hospital

Abstract

Aims: This case demonstrates the adverse sequelae that can follow a traumatic dental injury at a young age. It also highlights the importance of taking a full history and undertaking a thorough exam, independent of the information in the referral.
Case presentation: A 9-year-old boy was referred for treatment of "hypoplastic and non-vital upper left incisors" and "an extra tooth on radiograph". Clinical examination revealed a sinus tract labial to upper incisors (21,22). An increased probing depth was also recorded between the two teeth. However, the teeth responded positively to sensibility testing, had normal mobility and were not tender to percussion. The child had no history of recent trauma, but the mother reported that the he sustained a fall as a baby and lost one baby tooth that was never recovered. The history and clinical examination suggested that the most likely diagnosis was a complete intrusion of the upper left primary incisor with subsequent damage to the developing teeth (21, 22), manifested as enamel hypoplasia and malalignment. Management included removal of the intruded primary tooth and monitoring of the hypoplastic permanent incisors until complete eruption and root maturation (2-year follow up). Aesthetic restorations were then provided. The patient was referred for orthodontic correction of the malalignment.
Conclusion: Incorrect diagnosis and inappropriate management of dental trauma can cause additional damage. In this case, endodontic therapy in the permanent incisors was avoided by correct diagnosis at assessment. Clinicians have to assess correctly and justify their decisions on each individual case.

Introduction

Traumatic dental injuries are common in both primary and permanent dentitions in children. In a review of the literature, it was estimated that about one-third and one-fourth of children sustained dental injuries to the primary and permanent dentitions respectively (Glendor, 2008). The overall reported incidence of dental injuries in children and adolescents aged 0-19 years was estimated to be 4.5% (Lam et al. 2016). Dental trauma prevalence and incidence are generally high worldwide, however, reported figures can vary considerably across countries (Petti et al. 2018). This variation is not only due to environmental and cultural differences (Glendor, 2008), but also due to the lack of a standardized classification and recording system for dental injuries (Feliciano,2006). The cause and presentation of dental injuries can also vary widely among different age groups (Oldin et al. 2015). In the primary dentition, the predominant cause of injuries is falls (Flores et al. 2018). This is possibly related to lack of motor coordination in young children and is sometimes due to the child's inability to evaluate risks (Gupta, 2011; Andrade et al. 2021). Incisors are the most commonly affected teeth owing to their most exposed position in the dental arch.

Luxation type of injuries are more frequently seen than fractures in the primary dentition due to the resilience and pliability of the alveolar bone in young children (Flores et al. 2018). Injuries to the primary dentition are often overlooked, mainly due to less concern given by parents to primary teeth and limited cooperation for examination and management in young children (Gupta, 2011). Nevertheless, complications such as discoloration, pulp necrosis, obliteration of the pulp canal, pathological root resorption and premature loss of the primary tooth may occur in traumatized teeth (Lauridsen et al. 2017; Andrade et al. 2021). Moreover, traumatic dental injuries in the primary dentition can adversely affect the developing permanent teeth due to the proximity between the apices of the primary teeth and the developing successors. This close anatomic relationship explains why injuries to primary teeth can be easily transmitted to the permanent dentition. The age of the child, the developmental stage of the permanent tooth germ, and the severity and the direction of trauma are all important variables that dictate the extent of tooth damage in developing teeth (La Monaca et al. 2019, Lenzi et al. 2015)

Careful clinical and radiographic examination of dental injuries along with early diagnosis, timely intervention and regular follow-up are essential to prevent and minimize complications. The International Association of Dental Traumatology (IADT) guidelines recommend that children with intrusion/avulsion injuries to their primary teeth receive checkups until eruption of the permanent teeth for the early diagnosis and treatment of possible sequelae (Day et al. 2020). Misdiagnosis and incorrect treatment of dental injuries can further damage the traumatized teeth and lead to unsatisfactory outcomes. This case shows incorrect diagnosis of the original trauma in the primary dentition as well as misinterpretation of its adverse sequalae in the permanent teeth years later. The current report highlights the importance of taking a full history and undertaking a thorough exam, independent of the information or diagnosis in the referral.

Case report

A 9-year-old Nigerian boy was referred by his general dentist for “root canal treatment of hypoplastic and necrotic upper left incisors” and removal of “a supernumerary tooth” in the region. The child was seen by the specialized dental team in the Trauma Clinic at the Dublin Dental University Hospital. The chief complaint was concern about “discolored and rotated top front teeth with pus discharge in the area”. No history of recent trauma was reported. The child was otherwise physically well with clear medical background.

Clinical examination and diagnosis

Clinical examination revealed hypoplastic and malaligned 21& 22 with a labial sinus tract between the two teeth (Figure 1). An increased probing depth, in line with the sinus tract, was also recorded between the two teeth (highest reading 9 mm mid-buccal of 22). However, the teeth responded positively to cold sensibility testing with ‘Endo-Frost’ ((Roeko;, Germany), had normal mobility and were not tender to percussion. The child had otherwise intact and caries-free dentition with no previous dental treatment.

Two periapical radiographs at different angles were obtained to locate the “extra tooth”. Using the horizontal parallax (Jacobs, 2000), the tooth appeared to be in a labial position (Figure 2). In the same projections, a gutta-percha point was used to trace the origin of the sinus tract. The radiographic evaluation revealed the abscess was related to the “extra tooth” between teeth 21&22 (Figure 2).
Detailed questioning of parents revealed a traumatic dental injury at the age of 18 months. The mother reported that the child had fallen off his bed at home and “lost” one of his “baby” teeth that was never found at the time of injury. The mother sought assessment at Accident and Emergency service, however, the missing tooth was erroneously diagnosed as an avulsion by the attending physician. No further intervention was provided and no follow up was recommended. A full history and thorough clinical examination, independent of the information in the referral letter, revealed that these permanent incisors were not necrotic and had no sign of pulp degeneration. The ‘extra’ tooth in the radiograph was assumed to be a completely intruded primary incisor and not a supernumery tooth. Use of the gutta percha tracing correctly identified the impacted primary tooth as the source of infection. There was no indication of the duration of the infection as no previous radiographs were available.

Treatment plan and progress

Extraction of the abscessed primary tooth was planned and completed under general anesthesia due to potential behavior management problems and the complicated access to the intruded tooth. (Figure 3). Closer inspection of the removed tooth revealed a primary incisor and confirmed the preliminary diagnosis. Furthermore, the tooth was located buccal to the cortical plate in a subperiosteal position and was not incorporated in the growing maxilla. The hypoplastic permanent incisors were partially erupted, therefore decision was made to closely monitor these teeth with intensive prevention until complete eruption.

At the postoperative review (2 weeks after the surgery), there was a satisfactory healing with complete resolution of the sinus tract. The periodontal examination showed resolution of the increased probing depths. The patient was then placed on a 3-monthly recall interval to monitor development and eruption of the upper left incisors. Intermittent sensitivity later developed in the hypoplastic teeth, and desensitizing agents (e.g., tooth mousse) were used and oral hygiene instructions were reinforced. Continued follow-up showed normal eruption rate for the upper left permanent incisors with appropriate root formation and satisfactory apical closure confirming pulp vitality and favorable outcomes in these teeth (Kenny et al. 2018) (Figure 4).

Following complete eruption of the hypoplastic incisors, aesthetic restorations were provided with light-cured composite (Z350; 3M ESPE, St. Paul, MN, USA) using a minimally invasive cavity preparations. The aesthetic improvement re-established the patient’s self-esteem, and controlled tooth sensitivity (Faraoni-Romano et al.2017) (Figure 5). Alignment of the dentition will require orthodontic treatment and improved aesthetic restorations can be considered in the future for the hypoplastic teeth following completion of orthodontic therapy.

Discussion

In the primary dentition, intrusive luxation is considered one of the most severe forms of dental injuries that often leads to tissue damage and serious complications. Such injuries require careful examination not only for the traumatized tooth but also for possible sequelae to the permanent tooth germ. Sequelae in the permanent dentition may occur following dental trauma to their predecessors. A range of developmental alterations may manifest in permanent teeth; these include a white or yellow-brown discoloration, or circular enamel hypoplasia; crown dilaceration; root duplication; vestibular or lateral root angulation or dilaceration; partial or complete arrest of root formation; sequestration of the permanent tooth germ; and disturbed eruption (Andreasen & Flores, 2007; Flores & Onetto 2019; Goswami et al. 2020; Caeiro-Villasenín, Lucía et al. 2022). The type of sequelae that can be seen in the permanent dentition can be explained partly by the age at which the trauma to the primary teeth occurred. Developmental disturbances involving the crown of the permanent teeth are reported more frequently than developmental disturbances in the roots and in the eruption (Altun&Zafer, 2009), this is attributed to the fact that most traumatic injuries to primary teeth occur when children are between 1 and 3 years of age, which the time corresponding to crown formation and calcification of permanent incisors. In this case, the permanent incisors were hypoplastic and malaligned subsequent to intrusive luxation in the primary dentition. In a recent systematic review of the literature, enamel discoloration and/or hypoplasia were found to be the most common sequelae in the permanent teeth after trauma to the primary predecessor (Caeiro-Villasenín, Lucía et al. 2022).

Current IADT guidance suggests that all intrusive luxations be allowed to spontaneously re erupt, however, parents should be informed to watch for any unfavorable outcomes and advised to return to the clinic as soon as any unfavorable outcome is identified (Day et al. 2020). It is very important that parents are also informed about any possible damage or complications in the developing permanent teeth. The guidelines highlight the need to follow severe injuries especially intrusion and avulsion of primary teeth up until the eruption of the permanent teeth for early diagnosis and timely management of any complications. In this case, insufficient information was given to parents at the time of the original trauma, and no follow on management occurred.

This report represents an unusual case of complete intrusion of a primary incisor that had failed to re-erupt and remained undiagnosed for years until it developed necrosis and infection. Tooth loss (avulsion) was mistakenly assumed in the first place following the injury based on the clinical presentation only. No radiographic evaluation was carried out at that time to confirm the clinical diagnosis. The need for radiographic assessment of dental injuries cannot be overemphasized, particularly in situations where teeth appear to be missing to ensure that they are not completely intruded (Meyers, 2019). Radiographic assessment should be done at the initial appointment, not only for accurate diagnosis, but also to establish a baseline for future comparison (Moule & Cohenca, 2016).

A report in the literature was located where an intruded primary incisor remained undiagnosed for 15 years (Belostoky et al.1986). It was accidently discovered on radiographic evaluation for orthodontic treatment, the tooth was initially assumed to be a mesiodens, however, a closer inspection of the structure following its surgical removal revealed a deciduous tooth crown

which had undergone irregular resorption (Belostoky et al.1986). On questioning, the parents recalled the child sustained a fall at 10 months of age and "lost" one of her primary incisors. The permanent incisors were not affected by the injury, and this was attributed to the labial displacement of the traumatized tooth away from the developing successors. It could be also assumed that the developing tooth germs would have been at their earliest stages of development therefore they were not evidently affected by the injury. In this case report, the permanent incisors were hypoplastic and malaligned. At the age of 18 months (when the injury occurred), the permanent incisors are expected to be at the crown formation and calcification stage. It is likely that the path of intrusion had injured and displaced the developing germs of teeth (21 & 22) resulting in hypoplasia and rotation. In fact, intrusive luxation bears the highest risk of damaging the permanent tooth germ. Lauridsen et al. suggested the damage may be due to direct mechanical injury caused by the displaced primary tooth or by long- term complications such as pulp necrosis and infection with periapical inflammation or impaction of the primary tooth (Lauridsen et al. ,2012). In the present case, the two likely causes of damage exist. The displacement and rotation of the teeth is a likely consequence of deflection around the intruded tooth.

Conclusion and clinical implications

Dental injuries in young children can have a significant negative impact on oral health with esthetic, functional and psychological consequences. Careful clinical and radiographic examination along with regular follow-up is essential in all traumatic injuries. Organization of a proper emergency services and first aid for dental trauma is paramount at all pediatric hospitals with the presence of dental professional at the initial assessment. Onward referral to a dentist after the acute emergency should be an essential component of management of traumatic dental injuries. All dental professionals should be aware of and follow the guidelines within the International Association of Dental Traumatology (IADT) for the management of traumatic dental injuries (Levin et al. 2020; Fouad et al. 2020; Day et al. 2020; Bourguignon et al. 2020). Inaccurate or incomplete diagnosis and subsequent inappropriate treatment protocol can cause additional damage and unsatisfactory outcome in dental injuries. Clinicians have to always make their own decision on each individual case independent of the information or preliminary diagnosis from the referring dentist.

References

1. Andrade, M. R. T. C., Americano, G. C. A., da Costa, M. P., Lenzi, M. M., & Campos, V. (2021). Traumatic injuries in primary dentition and their immediate and long-term consequences: a 10-year retrospective study from the State University of Rio de Janeiro, Brazil. *Eur arch of Paediatr Dent,* 22(6), 1067-1076.
2. Andreasen J.O., Flores M.T. Lauridsen, E. Injuries to developing teeth. In: Andreasen JO, Andreasen FM, Andersson L, editors. Textbook and color atlas of traumatic injuries to the teeth. 5th ed. John Wiley & Sons ; Copenhagen: Munksgaard; (2018). p. 589–618.
3. Belostoky, L., Schwartz, Z., & Soskolne, W. A. (1986). Undiagnosed intrusion of a maxillary primary incisor tooth: 15-year follow-up. *Pediatr Dent*, *8*(4), 294-296.
4. Bourguignon, C., Cohenca, N., Lauridsen, E., Flores, M. T., O'Connell, A. C., Day, P. F., ... & Levin, L. (2020). International Association of Dental Traumatology guidelines for the

management of traumatic dental injuries: 1. Fractures and luxations. *Dental Traumatology*, *36*(4), 314-330.
5. Caeiro-Villasenín, L., Serna-Muñoz, C., Pérez-Silva, A., Vicente-Hernández, A., Poza-Pascual, A., & Ortiz-Ruiz, A. J. (2022). Developmental Dental Defects in Permanent Teeth Resulting from Trauma in Primary Dentition: A Systematic Review. *Int. J. Environ. Res. Public Health, 19*(2), 754.
6. Day, P. F., Flores, M. T., O'Connell, A. C., Abbott, P. V., Tsilingaridis, G., Fouad, A. F., ... & Levin, L.(2020). International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition. *Dent Traumatol*, *36*(4), 343-359.
7. Faraoni-Romano, J. J., Azevedo, D. T., Almeida, C. G., Geraldo-Martins, V. R., & Palma-Dibb, R. G. (2017). Restorative treatment on permanent teeth with enamel hypoplasia caused by trauma to the primary predecessors. *J Dent Health Oral Disord Ther*, *8*, 00288.
8. Feliciano K.M, de França Caldas A Jr.(2006). A systematic review of the diagnostic classifications of traumatic dental injuries. *Dent Traumatol*. 22(2),71–76.
9. Flores M.T, Onetto J.E. (2019). How does orofacial trauma in children affect the developing dentition? Long-term treatment and associated complications. *Dent Traumatol.* 35(6),312-323.
10. Flores, M.T, Holan, G., Andreasen, J.O., Lauridsen, E. Injuries in the primary dentition . In: Andreasen, J. O., Andreasen, F. M., & Andersson, L. (Eds.). Textbook and color atlas of traumatic injuries to the teeth. 5th ed. John Wiley & Sons;2018.p.556-84
11. Fouad, A. F., Abbott, P. V., Tsilingaridis, G., Cohenca, N., Lauridsen, E., Bourguignon, C., ... & Levin, L. (2020). International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. *Dent Traumatol*., *36*(4), 331-342.
12. Glendor U., 2008. Epidemiology of traumatic dental injuries–a 12 year review of the literature. *Dent Traumatol*. 24(6), 603–611.
13. Goswami, M., Rahman, B., & Singh, S. (2020). Outcomes of luxation injuries to primary teeth-a systematic review. *J Oral Biol Craniofac Res, 10*(2), 227–232.
14. Gupta, M., (2011). Intrusive luxation in primary teeth–Review of literature and report of a case. *Saudi Dent J*, *23*(4),167-176.
15. Jacobs SG., (2000). Radiographic localization of unerupted teeth: further findings about the vertical tube shift method and other localization techniques. *Am J Orthod Dentofacial Orthop*. 118(4):439-47.
16. Kenny KP, Day PF, Sharif MO, Parashos P, Lauridsen E, Feldens CA, Cohenca N, Skapetis T, Levin L, Kenny DJ, Djemal S, Malmgren O, Chen YJ, Tsukisboshi M, Andersson L. (2018). What are the important outcomes in traumatic dental injuries? An international approach to the development of a core outcome set. *Dent Traumatol.*34(1):4-11.
17. La Monaca G, Pranno N, Vozza I, Annibali S, Polimeni A, Bossù M, Cristalli MP. (2019). Sequelae in permanent teeth after traumatic injuries to primary dentition. *Minerva Stomatol.* 68, 332–340
18. Lam, R. ,2016. Epidemiology and outcomes of traumatic dental injuries: a review of the literature. *Aust Dent J*, 61, 4-20.
19. Lauridsen, E., Blanche, P., Yousaf, N., & Andreasen, J. O. 2017. The risk of healing complications in primary teeth with intrusive luxation: A retrospective cohort study. *Dent Traumatol.*, 33(5), 329-36.
20. Lenzi MM, Alexandria AK, Ferreira DM, Maia LC. (2015). Does trauma in the primary dentition cause sequelae in permanent successors? A systematic review. *Dent Traumatol*.31,79-88.

21. Levin, L., Day, P. F., Hicks, L., O'Connell, A., Fouad, A. F., Bourguignon, C., & Abbott, P. V. (2020). International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: General introduction. *Dent Traumatol ,36*(4), 309-13.
22. Moule, A., & Cohenca, N. (2016). Emergency assessment and treatment planning for traumatic dental injuries. *Aust Dent J*, 61, 21-38.
23. Myers, G. L. (2019). Evaluation and diagnosis of the traumatized dentition. *J of Endo*, *45*(12), S66-S71.
24. Oldin, A., Lundgren, J., Nilsson, M., Norén, J. G., & Robertson, A. (2015). Traumatic dental injuries among children aged 0–17 years in the BITA study–A longitudinal Swedish multicenter study. *Dent Traumatol.* 31(1), 9-17.
25. Petti S, Glendor U, Andersson L. (2018). World traumatic dental injury prevalence and incidence, a meta-analysis-One billion living people have had traumatic dental injuries. *Dent Traumatol*. , 34(2):71-86.

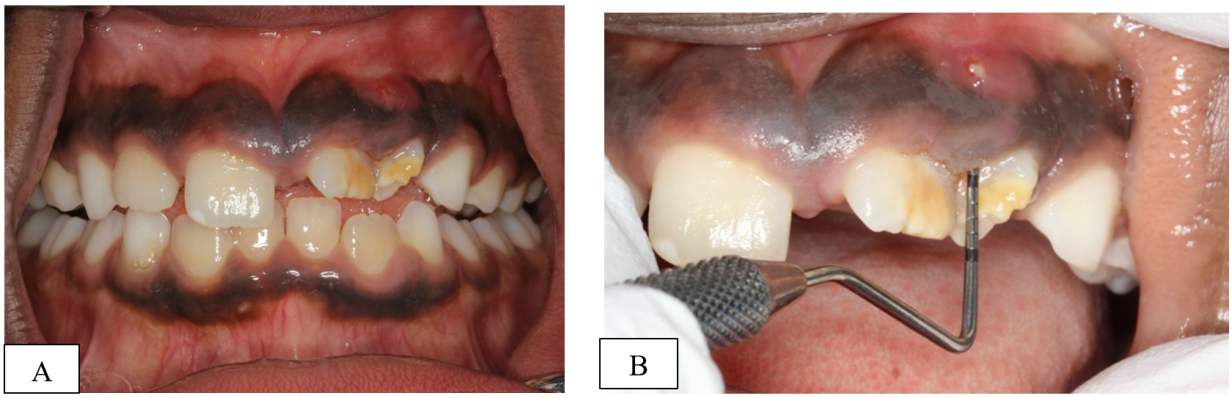

Figure 1: (A): frontal clinical view of patient's dentition at initial assessment, (B): closer view of the hypoplastic teeth (21&22) showing the labial sinus tract and the increased probing depth (9mm).

Figure 2: Periapical radiographs at initial assessment taken at different angles to locate the "extra tooth" with a Gutta-Percha point to trace the sinus tract

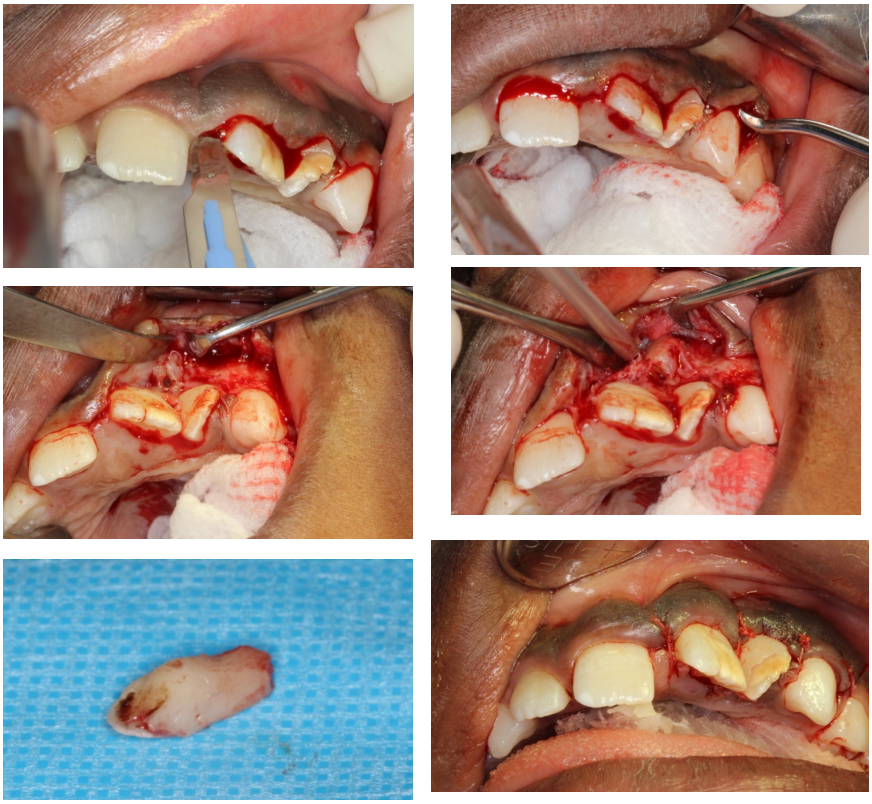

Figure 3: Intra-operative pictures for the surgical removal of the "extra" tooth. Notice the morphology of removed tooth that highly resemble a primary incisor with a mild crown fracture and some apical resorption.

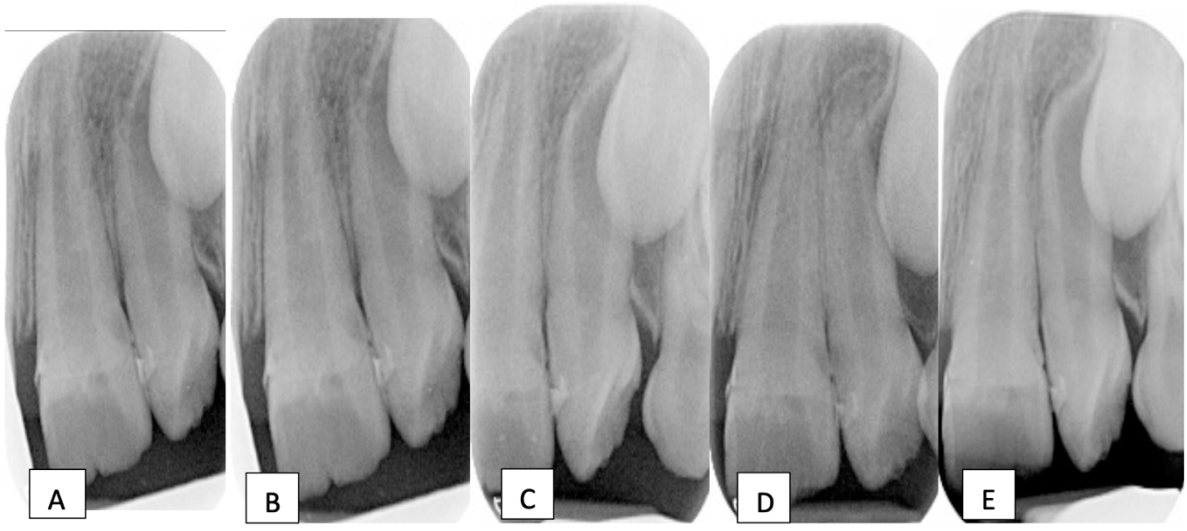

Figure 4: Radiographic evaluation of 11 & 21; (A) 2 weeks after the surgery (immediate postpoperative review),(B) at 3-month, (C) at 6-month,(D) at 12-month, (E) at 24-month recall visits. Notice the continued root development and the apical closure in the hypoplastic teeth.

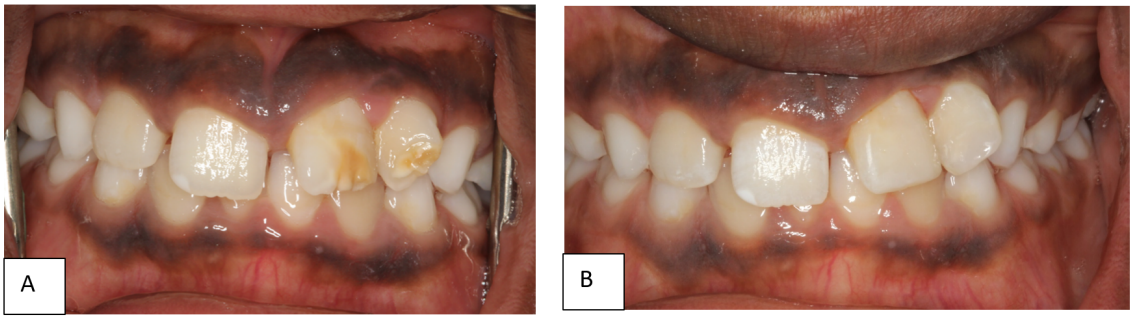

Figure 5: (A) the patient's teeth a 2-year follow up showing almost complete eruption of upper incisors. (B): the hypoplastic teeth after restoration with light-cured composite