Management of Tooth Avulsion in Adolescent: A case report

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Introduction

Tooth Avulsion is the complete displacement of tooth from its socket due to trauma. Avulsion of permanent teeth is seen in 0.5 - 3% of all dental injuries.[1] Most frequently the children experience dental avulsion in the age between 8 - 11 years old and most affected tooth is maxillary permanent central incisors.[2-3] The key for success in treatment of tooth avulsion is preservation of periodontium and supporting structure to prevent ankylosis or replacement resorption as there is a relationship between the length of extraoral period and occurrence of inflammatory and replacement resorption.[4-5] Immediate replantation of the avulsed tooth within 5 minutes at the place of accident is considered to be the best treatment. If this is not possible, the tooth should be kept in proper storage media to prevent dehydration of Periodontal ligament (PDL) cells.[6-8] Extraoral dry time is critical as the vitality of PDL is crucial for long term prognosis of replanted tooth.[9] Prolonged extraoral dry time leads to poor prognosis. After a dry time of 60 minutes or more, all PDL cells are non-viable.[6] Dentoalveolar ankylosis or replacement resorption occurs when an avulsed tooth is replanted after prolonged extraoral dry storage or after storage in an unsuitable medium,[10] milk is a suitable storage medium with the main advantages of high availability, a physiologic compatible pH and osmolarity with the PDL cells.[6-7,11-12] Tooth can also be transport in the mouth, keeping it inside the lip or cheek if the patient is conscious or spit in a container and place the tooth in it. The other suitable storage medias are Hank's Balanced Salt Solution (HBSS) or saline but avoid storage in water.[6-8]

After replantation the choice of treatment is related to the maturity of the root (open or closed apex) and the condition of PDL cells. Functional splinting for two or four weeks depends on the extra-oral dry time. Then perform root canal treatment to prevent pulpal infection and root resorption.[6,13] If the tooth had been kept dry longer than 60 minutes, performing root canal treatment prior or later to replantation.[6,14] Replanted teeth should be monitored by clinical and radiographic evaluation after 2, 4, 6 - 8 weeks, 3, 6 months, 1 year and yearly up to 5 years.[6,13,15]

Favorable outcomes of treated avulsed tooth are asymptomatic with normal mobility and normal percussion sound, no radiographic evidence of resorption or periradicular osteitis, normal lamina dura, whereas unfavorable outcomes are symptomatic with excessive mobility or no mobility (ankylosis) with high-pitched percussion sound, radiographic evidence of resorption, infrapo-sition of the tooth.[1,6,15] According to retrospective study on the sequelae in traumatized permanent teeth, avulsion was the injury with highest complication consisting of pulp necrosis, inflammatory root resorption, and replacement resorption.[16] Replacement resorption and ankylosis are common complications from severe dental trauma of permanent incisors. Replacement resorption rate varies and depend on age, basal metabolic rate, extra-alveolar time, treatment to the root surface prior to replantation, amount of root dentin at the time of trauma, severity of trauma and the extent of PDL necrosis.[17-18] The first clinical signs are lack of physiologic tooth mobility and metallic sound during percussion. Radiographic examination revealed the disappearance of PDL width and replacement of root dentin with bone. Conventional intraoral radiographic imaging is currently the clinical reference standard for the detection of external root resorption after luxation and avulsion injuries.[19] However radiographic examination is limited in early detection due to two-dimensional image and initial location of ankylosis is often on the labial and lingual surface.[20-21] Patel[22] compared the sensitivity and specificity of intraoral digital radiography imaging with Cone Beam-Computed Tomography(CBCT) scans , intraoral digital radiography imaging showed satisfactory accuracy, whereas CBCT showed perfect re-sults and also it was a valid and reliable technique for estimation the presence or absence of root resorption.[23] Clinical studies reveals that CBCT can provide the true size and position of all resorptive defect.[19] This case will demonstrate the management of avulsed tooth with prolonged extraoral period, non-physiological storage media and future complications.

Case Report

A 11-year old female patient presented to Dental Department of Pathumthani Hospital nearly two hours after a traumatic injury to her maxillary anterior teeth at the school playground. Patient arrived at the Emergency Department in an hour and then referred to the Dental Department afterward. The maxillary right permanent central incisor (Tooth 11) was avulsed and put in iced cold water by the school teacher. The maxillary left permanent central incisor (Tooth 21) was concussed but not

displaced. Patient was in good health and no contraindication for reimplantation and the maxillary right permanent central incisor root was completely formed. The tooth was cleaned and rinsed in sterile isotonic saline as well as the socket, then repositioned with finger pressure and non-rigid splinting with a soft 0.5mm twisted ligature wire (Medicon Tuttlingen Germany) on tooth 12, 11 and 21. Pre-operative radiograph was not obtained due to absence of evidence of remaining tooth structure in the socket and prolonged extra oral time. The patient was sent to receive 0.5ml tetanus toxoid and prescribed antibiotics Amoxycillin 500 mg 3 times a day for 7 days. Both patients and the parents were advised regarding treatment plan, long term prognosis and care of the injured tooth. Home care instruction was given: brushing teeth with soft toothbrush after each meal, soft diet for 2 weeks and avoiding participation in contact sports (Figure 1-2). Endodontic treatment was then initiated 10 days after the injury and splint removed 2 weeks after the injury. Endodontic treatment on right maxillary permanent central incisor (Tooth 11) was completed 5 weeks after the injury. One month later, tooth 21 had pain and negative response to vitality test and was diagnosed with Pulp necrosis with Symptomatic Apical Periodontitis and endodontic treatment was started (Figure 3). Tooth 11 was asymptomatic and radiographic examination was within normal limits and showed no sign of resorption or periapical lesion. Both the teeth are scheduled for follow-up every 6 months for 5 years.

Figure 1. Ten days after the trauma. Splinted teeth 12, 11 and 21

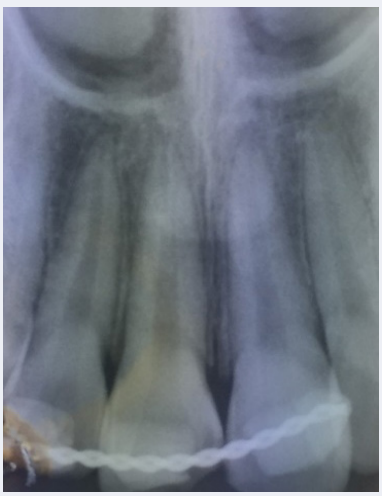

Figure 2. Ten days after the trauma. Periapical radiograph shows splinted teeth 12, 11 and 21, no periapical lesion or external resorption

Figure 3. Nine weeks after the trauma. Periapical radiograph Tooth 11 shows no periapical lesion or external resorption and Tooth 21 shows widening PDL space.

The first 2.5 years of follow-up both teeth are asymptomatic with physiological mobility, clinically normal percussion and radiographic examination shows no sign of root resorption. On the third year recall appointment both teeth show no sign of clinical abnormality except tooth 11 shows slight metallic sound and inconclusive small root resorption area at mesial aspect in the middle 1/3 of the root from radiographic examination (Figure 4). CBCT (DentiiScan2.0 FOV 8*8 cm. Voxel Size 0.2 mm^3, NECTEC, Bangkok, Thailand) was performed and both the maxillary permanent central incisors reveals no sign of root resorption or ankylosis and no periapical lesion (Figure 5-6).

Figure 4. Three years after the trauma. Periapical radiograph shows Tooth 11 no periapical lesion but inconclusive external resorption. Tooth 21 no periapical lesion or external resorption.

Figure 5. CBCT Tooth 11 no periapical lesion or external resorption.

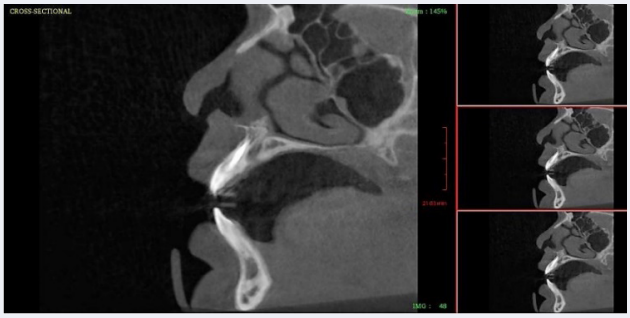

Figure 6. CBCT Tooth 21 no periapical lesion or external resorption.

Nine months later or 3 years 9 months after the injury, clinical examination of tooth 11 appears infra-occlusal position of tooth with gingival margin discrepancy in comparison with tooth 21 and metallic dull percussion sound. Other characteristics are normal gingiva, slightly reduced physiologic mobility, no sensitivity to percussion and palpation. Radiographic examination of tooth 11 shows signs of external root resorption size 1x3 mm. at mesial area around middle 1/3 and size 1.5 x 2 mm. at distal area around apical 1/3 of the root and disappearance of PDL space. The shortened crown of tooth 11 was built up with composite filling (3M Espe Filtek Z350 XT St.Paul MN USA) for esthetic compensation in comparison with tooth 21 (Figure 7,8).

Figure 7. Three years nine months after the trauma. Periapical radiograph Tooth 11 external root resorption (1x3 mm.) at the mesial area around middle 1/3 of the root and infra-occlusal position.Tooth 21 no periapical lesion or external resorption.

Figure 8. Three years nine months after the trauma. Clinic view of Tooth 11 shows infra-occlusal position and crown-lengthening composite build-up.

Discussion

Traumatized avulsion tooth needs to be reimplanted immediately or as soon as possible. The initial treatment at the site relies on the children parents, school teacher, or friends prior to dental professional and may varies from doing nothing to immediately replanting the teeth. Kargul[4] showed that a minority of avulsion injuries were seen within the first hour and also were stored in an appropriate medium, 40% of the teeth were seen within 1 hour and 42.5% were stored in appropriate medium. Once the patient show up at the dental clinic, assessment of the patient history especially the dry time of the tooth before it was placed replanted or placed in a storage medium is very important because cells of the PDL are irreversibly damaged.[6,15] Unfortunately, knowledge of the importance of maintaining an avulsed tooth in a storage medium is not always known, evidenced by the number of avulsed tooth presenting for treatment with extra-oral period in excess of 60 minutes.[14] Immediately after injury the avulsed tooth remained in her mouth and then stored dry in her hand for five minutes while notification her school teacher before it was put in iced cold water later, which is not a physiological storage media according to suggested dental trauma guidelines. The patient came to the emergency department an hour after the injury but due to other critical medical emergency cases, she was diagnosed and send up to the dental department half an hour later. Total extra-oral time was almost two hours exceeding the golden period time which is similar to other studies. These factors are associated with poor long term prognosis of this case due to non-viable PDL.[5-6]

The American Association of Endodontists suggested that endodontic treatment must be initiated two weeks after the tooth is reimplanted, and prior to removal of the splint. Treatment should not be initiated earlier as any manipulation of the tooth prior to or immediately after reimplantation can cause further damage to the PDL.[13] In cases with extra-oral dry time exceeding 60 minutes, root canal treatment can be carried out prior to replantation or later [6] and extraoral endodontics is not detrimental for teeth.[14] This case was replanted exceeding the maximum extra-oral time for favorable results according to Andersson[6]. Endodontic treatment was not performed extraorally because of insufficient dental chair time at that moment. Pulp extirpation was scheduled 10 days after the injury according to recommendation of Hinckfuss [24] that pulp extirpation should be done within 10 to 14 days of replantation. However this case started endodontic treatment earlier than the suggestion of AAE guidelines which stated that early endodontic treatment may cause further damage to the PDL.[13] Splint was removed two weeks after the injury. Tooth 21 began endodontic treatment after patient had clinical endodontic symptoms around nine weeks after the injury but had no other clinical or radiographic symptom until now due to non-displacement at the occurrence of injury.

Replacement resorption is an irreversible process and there is no treatment for its interruption.[25] Tooth replanted with necrotic PDL will usually become ankylosed and completely resorbed within 3-7 years in young patients whereas a tooth replanted under similar conditions in older patients may remain in function for a considerably longer time. The progression rate of root resorption varies with age and skeletal growth.[17-18] Majorana[26] studied root resorption in 1,943 dental trauma cases followed for five year and found that injuries occurred most often in maxillary incisors and root resorption was observed in 17.24% of the cases and 80% of the root resorption cases were associated with avulsion. Barrett and Kenny[27] found that 25% of the avulsed and replanted teeth with an extended extra-oral duration were loss, the majority failed within the first two years. Another series report of two cases with prolonged extra oral time of 7 and 27 hours were repositioned after extra-oral endodontic treatment resulted in clinical initial replacement resorption and ankylosis after 12 and 18 months respectively.[28] On the third year recall appointment, the 14 years old patient had clinical sign of mild infraposition on tooth 11 (Index I: amount of infraposition is <1/8 of the crown height of the adjacent teeth), slightly metallic sound, normal physiologic mobility and the periapical radiograph showed inconclusive small resorption at the mesial area around middle 1/3 of the root. A decision was made to confirm the diagnosis with CBCT. Even though the simplest highly specific and sensitive diagnostic test is subjective assessment of sound from percussing the tooth with a metal dental mirror handle but in this case, the sound pitch was not concrete.[29]

The decision to use CBCT imaging should be based on the diagnostic yield expected and in accordance with the "as low as reasonably achievable" (ALARA) principle. For most endodontic applications, limited Field of View (FOV) CBCT is preferred to medium or large FOV CBCT because there is less radiation dose to the patient, higher spatial resolution, and shorter volumes to be interpreted. It is recommended to use the smallest possible FOV, the smallest voxel size, the lowest mA setting, and shortest exposure time.[19] Lieke[30]studied the diagnostic ability of CBCT scans with different voxel resolutions in the detection of simulated external root resorption (ERR) and concluded that CBCT is a reliable method for the investigation and 0.3 mm voxel appeared to be the best protocol, associating good diagnostic performance with lower X-ray exposure which is similar to the study of Niknesshan.[31] Limited FOV CBCT should be considered the imaging modality of choice for diagnosis in patients who present with contradictory or nonspecific clinical signs and symptoms associated with untreated or previously endodontically-treated teeth like this case. Results of CBCT shows no sign of root resorption or ankylosis and no periapical lesion on both teeth, the next recall appointment were then schedule six months later. Interpretation of the CBCT scan was confirmed by two qualified interpreters, one is a faculty member in Department of Endodontics and the second is a faculty member in the Department of Oral and Maxillofacial Radiology. Unfortunately on the 3.5 years recall appointment, periapical radiograph of tooth 11 showed significant sign of ankylosis with external root resorption in the mesial area around middle 1/3 of the root and distal area around apical 1/3 of the root. Periapical radiograph also revealed disappearance of PDL space, other symptoms are infra-occlusal position (Index II: where amount of infra-position is greater than 1/8 but lesser 1/4 of the crown height of the adjacent teeth), reduced physiologic mobility and metallic dull sound when percussion. CBCT was taken into consideration in this case due to inconclusive diagnosis of ankylosis as suggested from the earlier reviews for it sensitivity criteria and the result showed no sign of resorption but later periapical radiograph showed disappearance of PDL and replacement resorption. Explanation of this outcome maybe from many possible factors such as the resorption process just began lesser than nine months ago and the small resorption-like area at 3 years recall was radiographic artifact or super imposed incisive foramen. Another factor maybe the slice thickness of the CBCT did not pass the resorption or the sensitivity quality of the machine itself even though it was perform at 0.2mm voxel which was smaller than the suggested voxel.

Management of tooth ankylosis could be composite build-ups, surgical luxation and orthodontic distraction, auto-transplantation, decoronation or extraction follow by implant replacement.[32-33] The complications that may develop as a consequence due to early loss of the traumatized tooth and local arrest of the alveolar bone development are inflammatory root resorption, esthetic problem, orthodontics complication, lack of mesial drift, tilting of adjacent teeth and arch length loss. To avoid these complications an ankylosed tooth should be removed before the changed interfere with future prosthetic and esthetic treatment.[34] Extraction of an ankylosed tooth may involve loss of attached bone, particularly the thin buccal plate of the maxilla. Decoronation technique was developed to prevent this complication by removing the crown of the ankylosed tooth leaving the root in the alveolus to be replaced by bone so it preserves buccopalatal ridge width and vertical height.[35] In growing child, decoronation is recommended when the infraposition is one-eighth to a quarter of the homologous tooth crown.[35-36] Indication for decoronation in early mixed dentition (before spurt of growth) is within 2 years of diagnosis when the infra-position becomes severe. If infraocclusion is detected during late mixed dentition (during the growth spurt) or in early permanent dentition which increase in infraposition is sometimes slow, decoronation might not be necessary but strict annual follow up is important.[36] Patient who surpassed the pubertal growth peak, benefits of decoronation can do little to correct the alveolar ridge deformity and tooth infra-position.[37] This case ankylosis was diagnosed at the age of almost 15 years old which passed the growth spurt period, close follow up was scheduled to evaluate for the most appropriate treatment in the future after losing her tooth. Eventhough if ankylosis was diagnosed on the third year recall when she was 14 years old

passing her growth spurt stage, the management protocol will still be the same. Nevertheless, maintaining the tooth and surrounding bone for a few years can be considered a successful treatment method for growing patient.[15] An implant and crown or removable prosthesis are options to replace the missing right permanent central incisor at the age of complete facial growth. It is very important that when a decision is made to replant a tooth, it is crucial that the dentists and parents all assume responsibility for monitoring the child's dentition for signs of replacement resorption.[38]

In this case the patient arrived almost 2 hours after the injury and the tooth wasn't placed in an appropriate storage media which leads to poor prognosis of the tooth. The important factor is to educate the public to minimized extra oral dry time at the site of injury and send the patient for immediate treatment. Preventive campaigns about how and what media to store the tooth after the injury are essential to improve the prognosis of the case. Health care professionals, guardians and teachers should have knowledge on how to proceed with this kind of unexpected injuries.[6]

Conclusion

Avulsion of permanent teeth is one of the most serious dental injuries, a prompt and correct emergency management is very important for good prognosis. Patient in this case was treated according to the dental trauma guidelines and the tooth has successful function and esthetics for 3 years, which is beyond normal survival time. With some limitations and compromised tooth condition upon arrival, it is unavoidable for the unfavorable long term outcome. Advance technology for early detection of complication had been used to support treatment decision which is related with growth spurt of the patient. However the progression of ankylosis will be closely monitored for future appropriate treatment to maximize patient benefit.

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