SCIENCE INQUEST
Excellent in sharing scientific knowledge

Open Access
Case Report

Volume 1 Issue 1 *Journal of Dental Treatment and Oral Care*

Orthodontic Management of an Intruded Immature Permanent Incisor Following Re-Eruption Stagnation - Literature Review and Case Report

Mituro TH[1], Machibya FM[2] and Kahabuka FK[2*]

[1]Dental Department, Muhimbili National Hospital, Dar es Salaam, Tanzania
[2]Department of Orthodontics Paedodontics & Community Dentistry, School of Dentistry, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania

[*]**Corresponding Author:** Kahabuka FK, Department of Orthodontics Paedodontics & Community Dentistry, School of Dentistry, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania, Tel: +255 222 151 135, E-mail: febyy.kahabuka@gmail.com

Citation: Mituro TH, Machibya FM, Kahabuka FK (2017) Orthodontic Management of an Intruded Immature Permanent Incisor Following Re-Eruption Stagnation - Literature Review and Case Report. J Dent Treat Oral Care 1(1): 101

Received: June 01, 2017; **Published:** July 04, 2017

Abstract

Background: Intrusion is an injury considered one of the most severe luxation injuries to affect permanent teeth, a difficult injury to treat and is associated with several complications.

Aim: Presentation of management outcome of an intrusive luxation of immature permanent incisor.

The case: A seven years old girl who presented with severe intrusion of an immature maxillary permanent right central incisor.

Management and outcome: Initial management of waiting for spontaneous re-eruption resulted into partial re-eruption of the intruded tooth. No further re-eruption six months after injury compared to what was present at the seventh week. Orthodontic extrusion was done using a Nance appliance followed by Orthodontic brackets six weeks later. These resulted into complete re-eruption and proper alignment of the intruded tooth.

Conclusion: Orthodontic repositioning of an intruded maxillary permanent incisor can be successfully achieved using a modified Nance appliance even when commenced at a late time after un-progressive passive re-eruption.

Abbreviations: *MUHAS: Muhimbili University of health and Allied Sciences; IADT: International Association of Dental Traumatology; UK: United Kingdom*

Keywords: *Intrusive luxation; Nance appliance; Dental trauma; Premature permanent tooth*

Introduction

Background

Intrusion is a luxation injury where the tooth is axially displaced into the alveolar bone. The injury is often associated with damage to the alveolar bone, the periodontal ligament, the cementum and the pulp tissue [1,2]. It is considered one of the most severe luxation injuries to affect permanent teeth [1]. Intrusive luxation of permanent teeth was reported by Andreasen., et al. to involve more boys and children in the age group 6–12 years [3]. The injury is rare, contributing only 0.5% to 2% of injuries to the permanent dentition, 7.6% of injuries to permanent incisors, 5%–12% of dental luxations and 3% of all luxation injuries to permanent incisors [4-7].

Diagnosis

In the established dentition, diagnosis of intrusive luxation is based on a difference in the position of the incisal edges of affected and unaffected teeth. Whereas a high metallic tone on percussion is indicative of intrusion or lateral luxation in the established as well as the mixed dentition. Radiographic examination, with more than one view, is necessary and may reveal differences in apical levels, alveolar fractures or signs of damage to adjacent teeth [8].

Recommended management of Intrusive luxation in the permanent dentition

There is lack of general agreement on what constitutes the best treatment for intrusive luxation in children [9-11]. Decisions regarding treatment of intruded permanent teeth is based on; the maturity of the root and the severity of intrusion [1,12-14]. Root development has been shown to be an important determinant for the success of passive repositioning, Albadri., *et al*. stated that, since intruded teeth are at risk of replacement root resorption, treatment with low risk of this complication should be defined as the best method [1,9,12].

Teeth with incomplete root formation (open apex): Generally spontaneous re-eruption approach is recommended for management of intrusive luxation in teeth with open apices by individual scientists as well as the British Society of Pediatric Dentistry and the International Association of Dental Traumatology [1,3,8,15,16]. The benefit of allowing re-eruption is to reduce the risk of healing complications. Usually, signs of spontaneous re-eruption are seen within the first two weeks. Recommendation according to the United Kingdom (UK) National Clinical Guidelines and the International Association of Dental Traumatology are summarized in table 1 [8].

Severity of intrusion	UK	IADT
Mild (<3 mm)	Passive repositioning	Allow eruption without intervention. If no movement within few weeks, initiate orthodontic repositioning
Moderate (3-6 mm)	Passive repositioning (If passive repositioning (PR) not working within 2–3 weeks start orthodontic repositioning (OR)	
Severe (>6 mm)	Passive repositioning (If passive repositioning (PR) not working within 2–3 weeks start orthodontic repositioning (OR))	If tooth is intruded more than 7 mm, reposition surgically or orthodontically

Table 1: Recommendation for the management of intrusive luxation in permanent teeth with incomplete root formation

One of the drawbacks of this approach is that root resorption might become quite advanced during the waiting period. As the tooth is still intruded, endodontic intervention which is necessary to arrest the resorption process might not be possible due to lack of access [17]. Furthermore, Neto., et al. cautioned that there is a possibility of neighbouring teeth tipping or migrating into the space originally occupied by the intruded tooth, resulting in space loss [18].

Teeth with complete root formation (closed apex): The UK and IADT recommendations for management of intrusive luxation of tooth with complete root formation are similar (Table 2) [1,8].

Severity of intrusion	UK	IADT
Mild (<3 mm)	Passive repositioning. If not working within 3 weeks start Orthodontic repositioning	Allow eruption without intervention if tooth intruded less than 3 mm. If no movement after 2–4 weeks, reposition surgically or orthodontically before ankylosis can develop
Moderate (3-6 mm)	Surgical repositioning or Orthodontic repositioning	
Severe (>6 mm)	Surgical repositioning	If tooth is intruded beyond 7 mm, reposition surgically. Root canal therapy using a temporary filling with calcium hydroxide is recommended and treatment should begin 2–3 weeks after surgery. Once an intruded tooth has been repositioned surgically, stabilize with a flexible splint for 4–8 weeks

Table 2: Summary of treatment recommendations for intruded permanent teeth with complete root formation as per UK and IADT guidelines

The advantages of repositioning include relief of compression zones in the periradicular area, enabling better healing by cemental deposition rather than ankylosis [3]. Repositioning also enables early endodontic access which can help prevent the onset of inflammatory root resorption [19]. However, repositioning might inflict further trauma to the already damaged periodontal tissue, leading to an increase in complications during the healing period [3].

Other recommendations: Patient instructions and supportive treatment such as use of soft food for one week, good oral hygiene, brushing with a soft brush and rinsing with chlorhexidine 0.1 % which is beneficial to prevent accumulation of plaque and debris are recommended. The benefit of systemic antibiotic treatment in relation to pulpal or periodontal healing is unproven. The use of antibiotics is governed by clinical judgement (e.g., contamination, associated hard and soft tissue injuries). Root canal treatment is indicated only following diagnosis of pulp necrosis [8].

Complications

The intrusive luxation in permanent teeth is associated with complications namely; pulp necrosis, external inflammatory resorption, external replacement resorption and marginal bone loss [18]. A large proportion (97%) of inflammatory resorptions is arrested after long-term calcium hydroxide treatment [2]. Replacement resorption appears to be more frequent in mature than in immature teeth [20]. The occurrence of sequelae depends on the degree of root development, age of the patient and degree of intrusion. There is a lower incidence of pulp necrosis and root resorption in immature teeth due to higher chances for revascularization [3]. Besides, the more resilient alveolar bone in these patients cushions the blow to the periodontal ligament, thereby reducing subsequent damage [3,18]. Studies have suggested that intrusions up to 3.0 mm of teeth with closed root apices have an excellent prognosis, whereas intrusions greater than 6.0 mm have a poorer prognosis with greater chances of pulp necrosis and inflammatory root resorption [9,21].

Justification and Objective

In view of the nature of intrusive luxation injury, the available treatment alternatives, unavailability of skilled personnel and supplies to manage the injury in emerging economy countries, a conservative treatment alternative is favoured whenever a chance exists. Therefore this case is being presented to share our experience and management outcome of an intrusive luxation of an immature permanent incisor that was managed at the dental clinic of Muhimbili University of Health and Allied Sciences (MUHAS), in Dar es Salaam, Tanzania.

Case report

A seven years old girl was brought at the MUHAS dental clinic complaining of injury to the upper teeth following a fall on a slippery floor three days prior to the visit. There was no loss of consciousness or amnesia. The child was attended before at a lower health facility where antibiotics and analgesics were prescribed.

Generally, the child was healthy looking. Extraorally, there was a wound on the right side of the lower lip and the left submandibular lymph nodes were palpable. Intraoral examination revealed poor oral hygiene, two cut wounds on the lower lip with sloughs, lacerated and inflamed gums around the area of maxillary right permanent central and lateral incisors. Only a small portion of the incisal edge of the right maxillary permanent central incisor was visible in the oral cavity (Figure 1). The maxillary permanent left central incisor was not affected. An intraoral periapical x-ray was taken which revealed an intruded maxillary permanent central incisor with open root apex (Figure 2). A diagnosis of soft tissue injury and severe intrusion of the maxillary permanent right central incisor was reached.

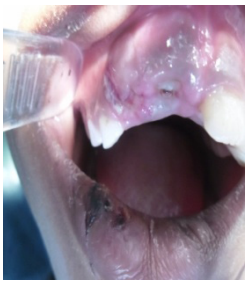

Figure 1: A picture showing lacerated wounds on the lower lip and incisal edge of an intruded upper right central incisor

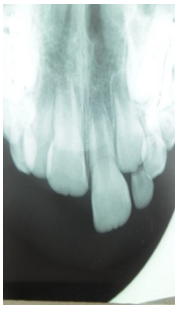

Figure 2: An intraoral periapical X-ray showing intruded upper right central incisor with an open apex

The UK National Clinical Guidelines recommendation was chosen [1]. That is; to wait for spontaneous re-eruption of the intruded tooth regardless of the degree of intrusion. Furthermore, wound debridement with Hydrogen peroxide

and normal saline was done. Chlorohexidine mouthwash and metronidazole gel were added to previous prescribed medications. Use of soft diet and meticulous oral hygiene were emphasized. The child was scheduled for recall visits to monitor passive re-eruption and any complications at 2, 4 and 7 weeks after injury according to a follow up schedule by the International Association of Dental Traumatology [8].

The child was brought for first follow-up two weeks after injury. On examination, the wound on the lower lip and gums were healed and inflammation had subsided. At this visit no re-eruption had occurred (Figure 3).

Figure 3: A photograph of a child two weeks after injury with no signs of re-eruption

Four weeks after injury

The child was recalled to the clinic four weeks post injury to assess the status of spontaneous re-eruption. On examination, about 2 mm of the intruded tooth was seen in the oral cavity (Figure 4). The child had no complaint therefore she was recalled after six weeks according to the follow up schedule by International Association of Dental Traumatology [8].

Figure 4: A photograph of a child four weeks after injury showing signs of re-eruption

Seven weeks after injury

At the seventh week after injury the tooth had slightly re-erupted to a total of 4 mm (Figure 5). Similar to the situation on the previous visit, the child had no complaint. Therefore she was rescheduled for a follow up six months after injury as per IADT recommendation [8].

Figure 5: A photograph taken seven weeks after injury showing about four millimeters re-eruption of the upper right central incisor

Six months after injury

The child was brought to the clinic six months after injury. No further re-eruption of the intruded tooth was seen

(Figure 6) compared to what was present at the seventh week (Figure 5). A decision was therefore made to reposition the tooth orthodonticaly.

Figure 6: A photograph showing an intruded upper right permanent incisor six months after injury without further re-eruption

Extrusion of the intruded upper right permanent incisor was done stepwise starting with impression taking followed by fabrication of Nance appliance in the dental laboratory, (Figure 7).

Figure 7: A Nance appliance on the cast model

The appliance was then delivered to the child. In order to create tension on the intruded tooth, an orthodontic button was bonded on the labial surface of the tooth and a power chain was used to connect the button and the Nance appliance (Figure 8). The child was recalled twice at an interval of two weeks for changing the power chain.

Figure 8: The Nance appliance connected to the intruded tooth

Six weeks after fitting the Nance appliance, two-thirds of the tooth crown was already visible in the oral cavity but the tooth was partially palataly inclining. Therefore, brackets were fitted for further tooth movement and proper alignment. For the purpose of increasing anchorage, the brackets were bonded from the upper right first molar to upper left lateral incisor (Figure 9).

Figure 9: A photograph showing the bonded brackets

The child was scheduled for follow up monthly for three months. At the third follow up visit after fitting the orthodontic brackets, the tooth was found to be properly aligned (Figure 10a), pulp sensibility test was normal and the tooth was not discoloured. The brackets were removed on the same day (Figure 10b).

Figure 10a: Properly aligned upper right central incisor

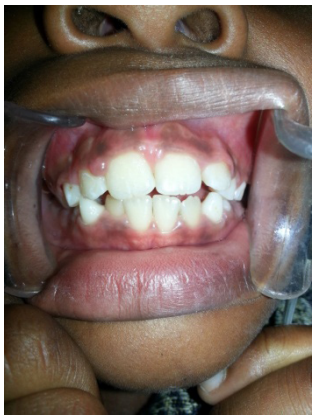

Figure 10b: The child's appearance after removing the brackets

Twenty four months after removal of the orthodontic brackets

The child was re-called for control two years after removal of the orthodontic brackets. The child had no complaints. On examination, the upper right central incisor looked similar to the contralateral tooth (Figure 11). An intraoral periapical X-ray revealed closed root apices of both the upper central incisors with signs of root canal obliteration of the right central incisor (Figure 12 and 14).

Figure 11: An intraoral photograph of the child two years after removal of orthodontic brackets showing a healthy upper right central incisor

Figure 12: An intraoral periapical X-ray of the upper central incisors with closed root apices and signs of root canal obliteration two years after removal of orthodontic brackets

Thirty months after removal of the orthodontic brackets

Thirty months after removal of the orthodontic brackets the child was recalled for follow up and monitoring of pulp condition. Clinically, the upper right central incisor showed no discolouration (Figure 13). On radiograph, there were

signs of pulp canal obliteration, (Figure 14), comparable to that observed on the previous visit (Figure 12). Pulp Sensibility tests (electric, heat and cold) were done. The upper right central incisor did not show positive response to heat and cold test but compared to the contra-lateral tooth it demonstrated slight delayed response to the electric test. This indicated presence of ongoing process of pulp necrosis. Consequently, the tooth was planned for root canal treatment.

Figure 13: An intraoral photograph of the child three and a half years after injury with no signs of discolouration of the injured tooth

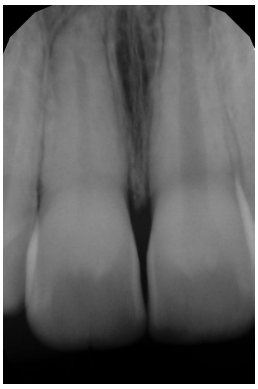

Figure 14: An intraoral periapical X-ray of the upper central incisors three and a half years after injury

Discussion

This article presents one of the severe types of luxation dental injuries to the permanent dentition which is often accompanied with several possible complications. The article describes the treatment provided and a three and a half years follow-up evaluation.

Waiting for spontaneous re-eruption of the intruded tooth was the chosen option in the current case according to the UK National Clinical Guidelines recommendation [1]. This approach is reported to yield the lowest number of complications (pulp and periodontal ligament) [3,22,23]. In the current case, substantial re-eruption was noted between the fourth and seventh weeks after injury, however remained stagnant as noted on the subsequent visits. Reasons for the stagnation were not established; probably it may be related to the stage of root immaturity. Although subsiding of the swelling due to soft tissue healing could have been mistakenly thought to be early signs of re-eruption, the fact that re-eruption was evident at the seventh week post injury without signs of persistent soft tissue inflammation suggested actual spontaneous re-eruption. Besides, the clinical and radiological examinations ruled-out signs of pulp necrosis and ankylosis.

The extent of traumatic destruction with individuals' body response to trauma have significant disease prognosis impact. Along with potential nerve damage, intrusive luxation can severely compromise blood supply to the pulp and surrounding periodontium. Re-eruption of intruded tooth will depend much on healing ability of the destructed periodontal tissue with proper blood and nerve supply. It is well known that pulp survival more likely occurs in immature than in mature teeth after luxation injuries and that revascularization may occur in dental intrusion and facilitate spontaneous re-eruption of immature teeth [24]. Unfortunately, trauma comes in many forms and does not always fit into distinct categories in terms of tissue damage, patient's age and individual's body response to trauma. The recommended management guidelines derived from research evidence should serve as relative general rules allowing for some changes to fit individual case's variations and specific clinical situation.

The initial spontaneous re-eruption in our case did not show obvious progress after seven weeks. The open root apex with lack of obvious signs of post-traumatic complications encouraged further waiting for re-eruption progression which did not occur in about four months waiting. Besides, mild re-erupsion signs that were observed after 7 weeks, delayed the conclusion of failed spontaneous eruption until 6 months after trauma. Spalding., *et al*. encountered pulp necrosis in one of the two cases with immature incisors with intrusive luxation initially treated with passive re-eruption approach [25]. The authors attributed the complication to the lack of immediate orthodontic repositioning which led to inadequate eruption. The case was resolved by late orthodontic re-positioning and calcium hydroxide apexfication. The four months waiting time given in the current case was based on the initial sign of spontaneous re-eruption, lack of alarming clinical and radiological features and the knowledge of high potential for spontaneous progressive re-eruption for immature intruded teeth.

To avoid possible risks for ankylosis, pulp necrosis, root and alveolar crest resorption, orthodontic re-positioning was started at six months after injury as further delay would put the tooth at risk of ankylosis especially in this patient with severe intrusion. As previously stated by Fields and Christensen, orthodontic treatment of displaced teeth can help in multiple ways: one being the possibility of tooth repositioning with light force during an extended time period, which allows the tooth to be completely repositioned with limited chances for complications [26]. In addition, the use of light repositioning forces through tissue reorganization allows eventual tooth repositioning into the correct position in relation to the adjacent teeth and the occlusion. Orthodontic repositioning has also been suggested as a possible alternative, which might allow for remodelling of bone and the periodontal apparatus. Andreasen and Andreasen have considered this option as the treatment of choice for both mature and immature permanent teeth. While, The Royal College of Surgeons of England suggests orthodontic extrusion for the management of mild intrusion [12,20].

The results of pulp sensibility test and root canal obliteration observed three and a half years after injury led to planning for root canal treatment of the upper right central incisor to minimise further complications. Since the tooth was not discoloured, after root canal treatment the tooth will stand a chance of staying in the oral cavity and serve both functional and aesthetic purposes before complex treatment procedures are inevitable.

Patients' compliance is another advantage of orthodontic repositioning. A painless orthodontic procedure in a child who went through a painful traumatic dental injury is likely to facilitate compliance with ultimate good patient's attitude towards dentistry. Although this is not the sole reason to consider orthodontic treatment, it may carry significant impact in patient's future dental perception. Surgical re-positioning is recommended mainly for mature intruded teeth. The patient under discussion did not fit in this category. Moreover, surgical re-positioning caries more risks than orthodontic approach. A significantly higher percentage of marginal bone loss, ankylosis, and pulpal inflammatory response have been demonstrated following surgical repositioning of intruded teeth in comparison to permitting spontaneous re-eruption or orthodontic repositioning [24].

The diversity of clinical presentation of intrusive luxation calls for customised appliance designs aiming at optimum tissue compatibility, facilitating good oral hygiene, efficient appliance with light, sustained forces, and easy to fabricate. In our case, a modified Nance appliance was constructed with anterior stainless steel loop extension for elastic chain attachment during initial orthodontic re-positioning phase (Figure 7). This was designed to avoid reciprocal force which could cause adverse effects on adjacent immature permanent and deciduous teeth required for anchorage with conventional fixed orthodontic appliance. At a later stage, fixed orthodontic appliance with super elastic arch-wire was used. The force delivered at this stage was considered safe, since the occlusal discrepancy had been significantly minimized by the initial phase and the maturity of adjacent anchor teeth was relatively advanced. The challenge of orthodontic appliance for re-positioning intruded teeth is reflected in previous works. A Hawley's appliance with modified labial bow was employed by Gauba., *et al*. in an attempt to prevent potential effects to immature permanent and deciduous teeth during orthodontic repositioning of maxillary incisors, while, Fields and Christensen successfully repositioned incisors with conventional orthodontic brackets bonded on some deciduous teeth [26,27]. They used continuous super elastic archwires and cautioned that teeth in both the anchorage and active portions of the wire may move and cause unanticipated changes, thus close monitoring of possible adverse effects to the anchor teeth must be observed.

Regarding loss of marginal bone support, there are inconsistent reports. Passive repositioning was found to be superior over active repositioning methods in a study by Andreasen., *et al*. Cunha., *et al*. also reported that the increase in age and advance in root development raised the risk of marginal bone loss. However, in another study, it was observed that the risk of marginal bone loss was greater in teeth treated conservatively than those treated actively (surgically or orthodontically re-positioned) [28,29].

In general all patients present with individual features and disease course which may not necessarily follow the documented trends. Although it is expected that passive repositioning can progress if initial re-eruption occurs within 2-3 weeks waiting time among immature intruded teeth, the repositioning did not progress after the initial re-eruption in the case under discussion [1]. The course prompted orthodontic intervention at a late stage, which successfully repositioned the tooth uneventfully. The case has therefore demonstrated successful repositioning of intruded tooth with delayed orthodontic intervention which may be applicable to many patients especially in developing countries where people tend to seek treatment at late stages of their disease [30].

Conclusion

Orthodontic repositioning of an intruded maxillary permanent incisor can be successfully achieved using a modified Nance appliance even when commenced at a late time after un-progressive passive re-eruption.

Recommendations

Based on the management outcome of the presented case, we recommend:

• Advocating the use of modified Nance appliance when extruding teeth in patients with limited number of teeth for conventional fixed orthodontic appliance.
• Considering delayed orthodontic repositioning of intruded teeth for un-progressive passive re-eruption as well as for patients seeking treatment at late stage.
• Opt for passive re-eruption as the first choice in the management of all forms of intruded premature permanent teeth.
• Before, during and after orthodontic repositioning, monitoring for possible pulpal changes should be closely done.
• Further studies on management of severe intruded premature permanent teeth.

Acknowledgement

The authors are indebted to the child patient and her mother for their support, compliance and consent to publication of this work.

References

1. Albadri S, Zaitoun H, Kinirons M (2010) UK National Clinical Guidelines in Paediatric Dentistry. Treatment of traumatically intruded permanent incisor teeth in children. Int J paed dent

2. Cvek M (1992) Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha. A retrospective clinical study. Dent Traumatol 8: 45-55.

3. Andreasen J, Bakland L, Matras R (2006) Traumatic intrusion of permanent teeth. Part 1. An epidemiological study of 216 intruded permanent teeth. Dent Traumatol 22: 83-9.

4. Borssen E, Holm A (1997) Traumatic dental injuries in a cohort of 16-year-olds in northern Sweden. Dent Traumatol 13: 276-80.

5. Glendor U, Halling A, Andersson L (1996) Incidence of traumatic tooth injuries in children and adolescents in the county of Vastmanland, Sweden. Swedish Dent 20: 15-28.

6. Zerman N, Cavalleri G (1993) Traumatic injuries to permanent incisors. Dent Traumatol 9: 61-4.

7. Andreasen J (1970) A clinical and radiographic follow-up study of 189 injured teeth. Scand J Dent Res 78: 273-86.

8. DiAngelis AJ, Andreasen JO, Ebeleseder KA, Kenny DJ, Trope M, et al. (2012) International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations of permanent teeth. Dent Traumatol 28: 2-12.

9. Al-Badri S, Kinirons M, Cole B (2002) Factors affecting resorption in traumatically intruded permanent incisors in children. Dent Traumatol 18: 73-6.

10. Sapir S, Mamber E, Slutzky-Goldberg I (2004) A novel multidisciplinary approach for the treatment of an intruded immature permanent incisor. Pediatr Dent 26: 421-5.

11. Wikén Albertsson K, Persson A, Lingström P, van Dijken JW (2010) Effects of mouthrinses containing essential oils and alcohol-free chlorhexidine on human plaque acidogenicity. Clin Oral Investig 14: 107-12.

12. Humphrey JM, Kenny DJ, Barrett EJ (2003) Clinical outcomes for permanent incisor luxations in a pediatric population. I. Intrusions. Dent Traumatol 19: 266-73.

13. Güngör H, Cengiz S, Altay N (2006) Immediate surgical repositioning following intrusive luxation: a case report and review of the literature. Dent Traumatol 22: 340-4.

14. Sönmez H, Tunç E, Dalcı Ö (2008) Orthodontic extrusion of a traumatically intruded permanent incisor: a case report with a 5-year follow up. Dent Traumatol 24: 691-4.

15. Tsilingaridis G, Malmgren B, Andreasen J (2012) Intrusive luxation of 60 permanent incisors: a retrospective study of treatment and outcome. Dent Traumatol 28: 416-22.

16. Chacko V, Pradhan M (2014) Management of traumatically intruded young permanent tooth with 40-month follow-up. Aust Dent J 59: 240-4.

17. Chan A, Cheung G, Ho M (2001) Different treatment outcomes of two intruded permanent incisors–a case report. Dent Traumatol 17: 275-80.

18. Neto JJSM, Gondim JO, de Carvalho FM, Giro EMA (2017) Longitudinal clinical and radiographic evaluation of severely intruded permanent incisors in a pediatric population. Dent Traumatol 25: 510-4.

19. de Alencar AHG, Lustosa-Pereira A, de Sousa HA, Figueiredo JH (2007) Intrusive luxation: a case report. Dent Traumatol 23: 307-12.

20. Andreasen JO, Bakland LK, Andreasen FM (2006) Traumatic intrusion of permanent teeth. Part 2. A clinical study of the effect of preinjury and injury factors, such as sex, age, stage of root development, tooth location, and extent of injury including number of intruded teeth on 140 intruded permanent teeth. Dent Traumatol. 22(2): 90-8.

21. Kinirons M, Sutcliffe J (1991) Traumatically intruded permanent incisors: a study of treatment and outcome. Br Dent J 170: 144-6.

22. Chaushu S, Shapira J, Heling I, Becker A (2004) Emergency orthodontic treatment after the traumatic intrusive luxation of maxillary incisors. Am J Orthod Dentofacial Orthop 126: 162-72.

23. Kenny D, Barrett E, Casas M (2003) Avulsions and intrusions: the controversial displacement injuries. Journal-Canadian Dent Assoc 69: 308-13.

24. Andreasen JO (1981) Periodontal healing after replantation and autotransplantation of incisors in monkeys. Int J Oral Surg 10: 54-61.

25. Spalding P, Fields H, Torney D, Cobb H (1985) The changing role of endodontics and orthodontics in the management of traumatically intruded permanent incisors. Pediatr Dent 7: 104-10.

26. Fields H, Christensen J (2013) Orthodontic procedures after trauma. J Endod 39: S78-87.

27. Gauba K, Goyal A, Bhatia S (2014) Intrusive Dental Injuries in Children: Manifestations and Management. J Postgrad Med Edu Res 48: 53-62.

28. Andreasen F, Pedersen B (1985) Prognosis of luxated permanent teeth—the development of pulp necrosis. Dent Traumatol 1: 207-20.

29. Cunha R, Pavarini A, Percinoto C (2002) Influence of surgical repositioning of mature permanent dog teeth following experimental intrusion: a histologic assessment. Dent Traumatol 18: 304-8.

30. Palenstein Helderman WH, Nathoo ZA (1990) Dental treatment demands among patients in Tanzania. Community Dent Oral Epidemiol 18: 85-7.