

ORIGINAL ARTICLE



Profile of intrusive luxation and healing complications in deciduous and permanent teeth – a retrospective study

Thais Rodrigues Campos Soares^a, Luciana Pereira Silva^a, Sabrina Loren de Almeida Salazar^a, Ronir Raggio Luiz^b , Patrícia de Andrade Risso^c and Lucianne Cople Maia^a 

^aDepartment of Pediatric Dentistry and Orthodontics, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil;

^bInstitute of Public Health Studies, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil; ^cDepartment of Dental Clinic, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

ABSTRACT

Objective: This retrospective study analyse the profile of intrusion in deciduous (DT) and permanent teeth (PT), the occurrence of healing complications (HC), type of treatments and predisposing factors.

Methods: The records of patients attended from 2005 to 2011 were analysed. Records of patients who had one or more intruded DT or PT were included in the study. Data collected from dental records included age, gender, attendance (immediate/mediate), healing complications and type of treatment. A Chi-square test and Logistic regression ($p \leq .05$) were performed to evaluate the associations between the type of teeth and presence of HC, as well as to explore the interactions between predisposing factors.

Results: The intrusion prevalence was 9.98% in DT and 2.45% in PT. Partial intrusion (57.3%) with palatal direction of the crown (61.8%) was most prevalent in DT, while complete intrusion (56.7%) with buccal direction of the crown (58.1%) was predominant for PT. Mobility was the most common HC in DT compared to root resorption in PT. Minimally invasive treatments were the most common therapy for DT compared to invasive treatments for PT. PT demonstrated increased HC when compared to DT ($p = .004$). A logistic regression illustrated that the level of intrusion and crown direction during the trauma did not influence the occurrence of HC ($p > .05$).

Conclusion: Intrusion's profile in DT and PT are different. PT showed more HC than DT, however the level of intrusion and crown direction were not associated with the presence of HC.

ARTICLE HISTORY

Received 28 November 2017

Revised 13 May 2018

Accepted 21 May 2018

KEYWORDS

Tooth intrusion; children; deciduous teeth; permanent teeth; healing complication

Introduction

Intrusion, defined as the axial displacement of a tooth into its own socket, is one of the most severe types of dental trauma due to the crushing of the periodontal ligament fibres, the neurovascular bundle and the alveolar bone [1]. Its frequency is dependent on studied populations and the methodology used, and varies between 9.3–12.5% in deciduous [2,3] and 0.3–2.0% among permanent teeth [4,5].

Deciduous teeth may present several types of healing complications from dental intrusion, such as pulp necrosis, enamel discoloration, internal and/or external root resorption, ankylosis and pulp canal obliteration [6–8]. Furthermore, there is always a potential chance of some disturbance in the eruption or formation of the permanent teeth due to the close proximity of the deciduous tooth root to the developing permanent tooth germ [6,9]. Alternatively, when intrusion occurs in permanent teeth it could potentially lead to healing complications, such as pulp necrosis, inflammatory radicular resorption, ankylosis, loss of marginal bone support, pulp canal obliteration, paralysis or disturbance of the radicular development and gingival retraction [10,11]. In addition to the clinical and

radiographic healing complications, dental trauma may cause pain, as well as aesthetic and functional problems that affect the quality of life of children [6,12,13].

Conservative management was characterized by attempting to maintain the tooth in the oral cavity, while the radical aimed at extraction [8]. In deciduous teeth, many authors recommend minimal invasive therapy using monitoring or endodontic therapy [8,14,15]. However, extraction may be performed in cases where there is risk presented to the permanent tooth germ or an inability of the patient to cooperate due to his/her young age [7]. In permanent teeth, endodontic therapy is indicated when necrosis or inflammatory root resorption is present [1], and varies according to root development [11,16]. When endodontic therapy is unsuccessful, or not possible, extraction is recommended, which increases the need for rehabilitation and treatment costs [1].

Therefore, traumatic dental injury is a dental public health problem in children and represents an emergency both because of the injury itself and the emotional distress caused to the patient and the parents [10,17,18]. Considering the importance of dental intrusion in public health, the purpose

of this article was to analyse the profile of intrusion in deciduous and permanent teeth, occurrence of healing complications, treatments and predisposing factors. The hypothesis of the present study is that there is no difference in the profile of intrusion in deciduous and permanent teeth, as well as in the occurrence of healing complications, in treatments and in predisposing factors.

Materials and methods

This retrospective observational study was approved by the Local Ethics Committee of the Hospital Universitário Clementino Fraga Filho/UFRJ (No.064/05). The survey was based on records of patients, who attended the Dental Trauma Surveillance Center (DTSC) of the Federal University of Rio de Janeiro, Brazil from 2005 to 2011. The DTSC, which follows the Andreasen's classification [1] for routine diagnostics is a reference dental trauma centre in the city of Rio de Janeiro. Dentists who performed the initial examinations and the emergency treatments were MSc students who had received prior training and were supervised by a senior professor with experience in dental trauma. The protocol of clinical and radiographic examination was the same as described by Soares et al. [19].

The sample set was comprised of patients from 0 to 12 years old who had one or more intruded deciduous and/or permanent teeth. Furthermore, for inclusion, it was required that the children are followed up at the DTSC for a minimum period of 3 months following initial attendance, according to previously observed methodology and results [20]. Records with incomplete data, patients who did not attend follow-up visits and those whose terms of free and informed consent had not been signed were excluded from the study.

Thus, the sample consisted of all records within the eligibility criteria previously mentioned. The authors sought to minimize the risk of bias by using a standardized dental record from a reference centre for dental trauma, in which the following data were collected: *age* (mean and standard deviation), *gender* (male/female), *place of trauma and reason for trauma*, *attendance* (immediate/mediate), *crown displacement* (buccal/palatal), *level of the intrusion* (complete/partial), *healing complications* and *type of treatment*.

The modified criteria [7] adopted for the evaluation of the level of the intrusion in deciduous teeth divided the intrusion into complete (i.e. up to 2 mm visible) and partial intrusion (i.e. more than 2 mm visible). Taking into account the patients between the ages of 6 and 12 could present intrusion into permanent teeth, so many of the intruded permanent teeth assessed would not be fully erupted at the time of trauma. In this way, a visual clinical evaluation was done using the comparison with the contralateral one to determine a partial intrusion (clinically visible coronary portion) or total intrusion (crown not clinically visible).

Healing complications can be considered alterations or sequelae that affect traumatized teeth, and may involve periodontal, pulpal or periradicular tissues and can occur weeks, months or even several years after the injury [1,20,21].

According to previously study, some healing complications can be observed in three months after the dental trauma, as pulp necrosis and inflammatory root resorption [20]. Others, complications like ankylosis and replacement resorption needs more time of follow-up to be diagnosed [1], so are not evaluated in this study.

The healing complications were classified according to the degree of severity in the following order proposed by authors: *no healing complication* < *coronary discoloration* < *mobility* < *pulp necrosis* < *abscess* < *inflammatory root resorption* [1,20].

The types of treatments were classified as minimally invasive (i.e. when only follow up with no clinical intervention was performed) and invasive (i.e. endodontic treatment or extraction).

Data analyses

All data were analysed using the descriptive analysis. To evaluate the association between type of teeth and presence of healing complications, the Chi-square test was used with a level of significance set at $p \leq .05$. A logistic regression analysis was performed to investigate the association between predisposing factors to complications (e.g. level of intrusion, crown direction) and on the occurrence of healing complications. Logistic regression was performed in General Linear Models (GEE) to consider the internal correlation of the observations of each patient's teeth ($p \leq .05$). The SPSS statistical software (version 21.0; SPSS Inc., Chicago, IL) was used.

Results

Records of 1022 patients attended in the period from 2005 to 2011 were evaluated and it was observed that 127 patients presented an intrusive luxation. Of these 127 patients, 102 children presented intrusion in the deciduous dentition, with a total of 162 deciduous teeth affected. On the other hand, 25 patients presented intrusion into the permanent dentition, with a total of 34 teeth affected.

Boys were more affected by trauma than girls in both teeth (Table 1). Intrusion in deciduous teeth is more prone to occur at home when compared to permanent teeth, where intrusion is more frequent on the street. Both deciduous and permanent teeth demonstrated high frequencies of immediate treatment as intrusions are considered to be an emergency situation.

The level of intrusion and direction of displacement of the crown was different for deciduous and permanent teeth. Partial intrusion (57.3%) with palatal direction of the crown (61.8%) was most prevalent for deciduous dentition, while complete intrusion (56.7%) with buccal direction (58.1%) of the crown was most common for permanent dentition (Table 2).

Mobility was the most prevalent healing complication in deciduous and inflammatory root resorption in permanent teeth. Minimally invasive treatments were the most common choices for deciduous teeth, while invasive treatments (e.g.

endodontic therapy and extraction) occurred most for permanent teeth (Table 2).

The Chi-squared test showed an association between type of teeth and the presence of HC, while permanent teeth demonstrated increased sequels compared to deciduous teeth ($p = .004$). Logistic regression demonstrated that the level of intrusion and crown direction during the trauma did not influence the occurrence of HCs in both deciduous and permanent teeth (Table 3).

Table 1. Data regarding the number of patients with intrusion in deciduous ($n = 102$) and permanent ($n = 25$) dentition.

	Patients with intruded deciduous teeth (%)	Patients with intruded permanent teeth (%)
Age ($\pm$ SD)	2.74 $\pm$ 1.8 years	8.84 $\pm$ 2.2 years
Female	37 (36.3)	4 (16.0)
Male	65 (63.7)	21 (84.0)
Place of trauma (%)		
Home	66 (64.8)	8 (32.0)
Street	23 (22.5)	10 (40.0)
School	8 (7.8)	6 (24.0)
Others	5 (4.9)	1 (4.0)
Cause of trauma (%)		
Fall from height	44 (44.4)	7 (28.0)
Other types of fall	33 (33.3)	6 (24.0)
Cycling accident	4 (4.0)	6 (24.0)
Sporting accident	1 (1.0)	3 (12.0)
Car accident	1 (1.0)	0 (0.0)
Others	16 (16.2)	3 (12.0)
Associated trauma (%)		
Only intrusion	94 (92.2)	17 (68.0)
Intrusion and dental tissue	8 (7.8)	8 (32.0)
Attendance after trauma (%)		
Immediately – 24 h	75 (73.5)	20 (80.0)
Mediate – after 24 h	27 (26.5)	5 (20.0)

Table 2. Data regarding intruded teeth features ($n = 196$).

	Deciduous teeth $n = 162$ (%)	Permanent teeth $n = 34$ (%)
Level intrusion ^a		
Partial	67 (57.3)	13 (43.3)
Complete	50 (42.7)	17 (56.7)
Crown direction ^a		
Buccal	47 (38.2)	18 (58.1)
Palatal	76 (61.8)	13 (41.9)
Clinical and radiographic healing complication		
Pulp necrosis	6 (3.7)	1 (3.0)
Mobility	25 (15.5)	8 (23.5)
Inflammatory Root resorption	14 (8.6)	11 (32.3)
Discoloration coronary	6 (3.7)	0 (0)
Abscess	6 (3.7)	1 (3.0)
No healing complication	105 (64.8)	13 (38.2)
Treatment		
Minimally invasive	119 (73.5)	14 (41.2)
Intervention	43 (26.5)	20 (58.8)

^aSome data could not be extracted from patient records.

Discussion

This study demonstrated that intrusive luxation is more prevalent in deciduous teeth than in permanent teeth. Several studies have related this circumstance to the fact that preschool children have a predilection to dental trauma as they are still developing coordination of movements and have few defensive reflexes [22–24]. In addition, at this age, physical activity increases and preventive care is very difficult [12]. Additionally, the alveolar bone in young children is more resilient. Therefore, blunt force trauma against these teeth often causes them to move instead of break, as they are not yet firmly supported [7,22].

The prevalence of intrusion in deciduous teeth in our study was similar to other published studies [2,3], while for permanent teeth the frequency was higher than observed in other studies [4,5]. This fact can be explained by the fact that DTSC is not only a referral centre for trauma care for toddlers and preschool children in the city of Rio de Janeiro, but also for schoolchildren and teenagers.

In agreement with other studies, males were more prone to intrusion than females [10,12]. As far as the aetiology is concerned, and in agreement with other studies, our results demonstrated that falls are the most frequent cause in both dentitions [6,7,10]. However, some studies showed home as the most common place of accidents, independent of the affected dentition [7,10]. Our study demonstrated a difference in the location of trauma in relation to deciduous and permanent teeth, where the home and the street are the most common places, respectively.

Previous studies with various methodologies demonstrated a higher frequency of complete intrusion in deciduous and permanent teeth [7,25]. Our results demonstrate that deciduous teeth have a higher frequency of partial intrusion. In Rio de Janeiro, we are an established and recognized dental trauma centre that provides treatment for many young children, which the municipal network cannot attend. Therefore, we routinely assess complex and simple cases, especially in the deciduous dentition. Simpler cases (partial intrusion) of permanent teeth are absorbed by public and private networks, but more complex cases are referred to our centre.

Several factors are associated with the presence of HCs following intrusion, including the level of intrusion, the presence of associated coronal fractures and the type of tooth involved [10,11,26]. The results demonstrated that mobility was the most common HC in intruded deciduous teeth. This condition must be related to the fact that in the deciduous teeth partial intrusion was the most prevalent, which could facilitate mobility. Additional factors that could explain the association between tooth and injuries to support tissues in young children are bone resilience and root length [7,22].

Table 3. Association between level intrusion and crown direction with the occurrence of healing complication.

Dependent variable	Type of teeth	Independent variable	p value	OR	IC (95%)
Presence of healing complication	Deciduous	Level intrusion – partial	.303	0.613	4.141–1.555
		Crown direction – buccal	.252	0.580	0.229–1.471
	Permanent	Level intrusion – partial	.877	0.864	0.137–5.435
		Crown direction – buccal	.352	2.316	0.394–13.599

In permanent teeth, the literature has shown that pulp necrosis is one of the most frequently diagnosed complications following traumatic intrusion [1,16,25]. Results demonstrated a higher prevalence of inflammatory root resorption in permanent teeth. These results may be related to the fact that permanent teeth have suffered an increased frequency of complete intrusions, considered of greater severity, and with the stage of root development [20,26].

When the factors associated with the presence of HCs were evaluated, no relationship was found with the level of intrusion and crown direction. However, primary teeth were statistically shown to have less chance to have HCs when compared to intruded permanent teeth. This result reinforces the importance of minimally invasive treatments in cases of intrusion in the deciduous dentition.

The decision for the best treatment for intruded teeth should take into account several aspects, such as the child's ability to comply, proximity to the permanent germ, stage of root formation and delay in seeking care [1,7,14,22,23]. Studies have shown that extraction was used as the treatment of choice for intrusion in deciduous teeth [7,23]. However, recent studies and several authors support the idea that extraction should be performed only when there is a clear risk to the germ of the permanent successor or when patient cooperation is difficult [8,14,15,22]. Our results demonstrated that minimally invasive treatment in the intruded tooth can be considered an adequate approach, even if there is a complete intrusion or with the buccal crown displaced.

With permanent teeth, the main objective of treatment should also be to retain the tooth in the mouth [1]. As the permanent tooth presented more HCs than the deciduous, invasive treatment was frequently used. For teeth with incomplete root formation and no healing complication, the traumatized tooth should be monitored [5].

Although we must consider the retrospective design as a limitation of this study, the data collected here pointed to the need for concept reviewing, such as the treatment for dental intrusion. There are no data in the literature regarding the ideal period to be considered for the evaluation of traumatic sequelae, mainly in primary teeth; therefore the data collection was based on a previous study in permanent teeth [20], in which the authors observed a greater number of sequelae in the period of 3 months. Therefore, the authors chose to use the minimum period of 3 months for inclusion of the records in this study, for both deciduous and permanent teeth. However, the authors emphasize that longer follow-up periods are extremely important in cases of trauma, especially in teeth with incomplete root development. As the mean age of patients with intact permanent teeth was 8.84 years, many patients had incomplete root development, suggesting that this group remained without sequelae during the evaluation period.

Despite the limitations of this study, the results presented may help the dentistry in the elaboration of the conservative treatment plan in cases of dental intrusions in deciduous teeth. Understanding that the intrusion profile is different according to the type of teeth evaluated is important in formulating prevention and care strategies for patients. The results presented here, serve as a warning to the fact that

permanent teeth should be monitored within a shorter consultation period to evaluate possible sequelae that may, in the long term, lead to exodontia. For deciduous teeth, the dentist should be aware that the level and the direction of intrusion did not act as an inductor of a great number of sequelae in the traumatized tooth in a short-term period, and for this reason the intruded deciduous teeth should be followed up for longer periods, until replacement. However, as the results presented do not take into account the possible sequels in the permanent successor (in cases of deciduous intrusion), more prospective studies are necessary to evaluate the sequelae in the traumatized deciduous tooth and in the successors taking into account the clinical variables in a longer evaluation time.

This study evaluated the characteristics related to intrusion in deciduous and permanent teeth to help dentists understand and improve patient care of those who have suffered dental intrusion. Our results demonstrated that differences between deciduous and permanent dentitions exist, particularly in relation with the place of trauma, the level and axis displacement of the tooth, the healing complication and the treatment of choice. Permanent teeth demonstrated increased HCs when compared to deciduous teeth; however, the level of intrusion and crown direction were not associated with the presence of healing complications.

Disclosure statement

The authors declare that they have no conflict of interest.

Acknowledgement

The authors acknowledge the financial support from CAPES and CNPq. This study is part of the PhD thesis of the first author.

ORCID

Ronir Raggio Luiz  <http://orcid.org/0000-0002-7784-9905>

Lucianne Cople Maia  <http://orcid.org/0000-0003-1026-9401>

References

- [1] Andreasen JO, Andreasen FM, Andersson L. Textbook and color atlas of traumatic injuries to the teeth. 4th ed. Copenhagen: Munksgaard; 2007.
- [2] Avşar A, Topaloglu B. Traumatic tooth injuries to primary teeth of children aged 0-3 years. *Dent Traumatol*. 2009;25:323-327. Jun
- [3] Cunha RF, Pugliesi DMC, Vieira AEM. Oral trauma in Brazilian patients aged 0-3 years. *Dent Traumatol*. 2001;17:210-212.
- [4] Skaare AB, Jacobsen I. Dental injuries in Norwegians aged 7-18 years. *Dent Traumatol*. 2003;19:67-71.
- [5] Andreasen JO, Bakland LK, Matras RC, et al. Traumatic intrusion of permanent teeth. Part 1. An epidemiological study of 216 intruded permanent teeth. *Dent Traumatol*. 2006;22:83-89.
- [6] Altun C, Cehreli ZC, Güven G, et al. Traumatic intrusion of primary teeth and its effects on the permanent successors: a clinical follow-up study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2009;107:493-498.
- [7] Carvalho V, Jacomo DR, Campos V. Frequency of intrusive luxation in deciduous teeth and its effects. *Dent Traumatol*. 2010;26:304-307.

- [8] Flores MT. Traumatic injuries in the primary dentition. *Dent Traumatol.* 2002;18:287–298.
- [9] Kuchler EC, Fidalgo TKS, Farinhas JA, et al. Developmental dental alterations in permanent teeth after intrusion of the predecessors: clinical and microscopic evaluation. *Dent Traumatol.* 2010;26:505–508.
- [10] Neto JJSM, Gondim JO, de Carvalho FM, et al. Longitudinal clinical and radiographic evaluation of severely intruded permanent incisors in a pediatric population. *Dent Traumatol.* 2009;25:510–514.
- [11] Gomes GB, da Costa CT, Bonow ML. Traumatic intrusion of permanent teeth: 10 years follow-up of 2 cases. *Dent Traumatol.* 2012;29:165–169.
- [12] Arikan V, Sari S, Sonmez H. The prevalence and treatment outcomes of primary tooth injuries. *Eur J Dent.* 2010;4:447–453.
- [13] Antunes LA, Luiz RR, Leão AT, et al. Initial assessment of responsiveness of the P-CPQ (Brazilian version) to describe the changes in quality of life after treatment for traumatic dental injury. *Dent Traumatol.* 2012;28:256–262.
- [14] Cunha RF, Pugliesi DMC, Percinoto C. Treatment of traumatized primary teeth: a conservative approach. *Dent Traumatol.* 2007;23:360–363.
- [15] Fidalgo TK, Maia LC. Minimally invasive intervention of acute trauma in the primary dentition: successful five-year follow-up. *Gen Dent.* 2012;60:158–161.
- [16] Tsilingaridis G, Malmgren B, Andreasen JO, et al. Intrusive luxation of 60 permanent incisors: a retrospective study of treatment and outcome. *Dent Traumatol.* 2011;28:416–422.
- [17] Andreasen JO, Andreasen FM. [Dental trauma: quo vadis]. *Tandlaegebladet.* 1989;93:381–384.
- [18] Marcenes W, Beiruti N, Tayfour D, et al. Epidemiology of traumatic dental injuries to permanent incisors of schoolchildren aged 9–12 in Damascus, Syria. *Dent Traumatol.* 1999;15:117–123.
- [19] Soares TRC, Risso PA, Maia LC. Traumatic dental injury in permanent teeth of young patients attended at the federal University of Rio de Janeiro, Brazil. *Dent Traumatol.* 2014;30:312–316.
- [20] Soares TRC, Luiz RR, Risso PA, et al. Healing complications of traumatized permanent teeth in pediatric patients: a longitudinal study. *Int J Paediatr Dent.* 2014;24:380–386.
- [21] Hecova H, Tzigkounakis V, Merglova V, et al. A retrospective study of 889 injured permanent teeth. *Dent Traumatol.* 2010;26:466–475.
- [22] Colak I, Markovic D, Petrovic B, et al. A retrospective study of intrusive injuries in primary dentition. *Dent Traumatol.* 2009;25:605–610.
- [23] Gondim JO, Moreira Neto JJS. Evaluation of intruded primary incisors. *Dent Traumatol.* 2005;21:131–133.
- [24] Shanmugam HV, Arangannal P, Vishnurekha C, et al. Management of intrusive luxation in the primary dentition by surgical repositioning: an alternative approach. *Aust Dent J.* 2011;56:207–211.
- [25] Wigen TI, Agnalt R, Jacobsen I. Intrusive luxation of permanent incisors in Norwegians aged 6–17 years: a retrospective study of treatment and outcome. *Dent Traumatol.* 2008;24:612–618.
- [26] Al-Badri S, Kinirons M, Cole B, et al. Factors affecting resorption in traumatically intruded permanent incisors in children. *Dent Traumatol.* 2002;18:73–76.