Sequelae and prognosis of intruded primary incisors: a retrospective study

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Abstract

Purpose: This study was designed to assess the sequelae and prognosis of intruded primary incisors.

Methods: Of 196 children who visited the emergency clinic due to intrusion of 310 maxillary primary incisors, 110 children (172 teeth) were available for follow-up examination (study group). Eighty-six children (138 teeth) did not show for the follow-up examination (non-respondents group). Male/female ratio was 1.7:1. Age range of children at time of injury was 12-72 months (mean 28). Follow-up time ranged between 0 and 59 months (mean 27).

Results: Fifty-seven percent of all teeth were completely intruded. In 80%, the root was pushed labially. All but two ankylosed teeth re-erupted, and 37% of these re-erupted into an ectopic position. Completely intruded incisors re-erupted into an ectopic position in a higher percentage (45%) than partially intruded teeth (30%). Fifty-two percent of the teeth presented pulp canal obliteration (PCO). Sixty-four percent of the completely intruded incisors presented PCO compared to 40% of partially intruded teeth. Arrest of dentin apposition was found in 15% of the teeth, and was not affected by the degree of intrusion. Twenty-three teeth were extracted shortly after the injury due to suspect of contact with the developing permanent successor (19 teeth) and severe caries (4 teeth). Sixty-eight percent of the intruded teeth survived more than 36 months after the injury. Twenty-three percent were extracted due to periodontal breakdown and 5% due to repeated trauma. Antibiotic therapy did not have any effect on the survival rate.

Conclusion: The majority of intruded primary incisors may re-erupt and survive with no complications after more than 36 months post trauma even in cases of complete intrusion and fracture of the labial bone plate. (Pediatr Dent 21:243-248, 1999)

Intrusive luxation has been defined as "displacement of the tooth deeper into the alveolar bone".[1] Some authors found intrusion to be the most common type of injury to the primary incisor region,[2, 3] while others reported intrusion to comprise 8-22% of all luxation injuries of primary anterior teeth.[4-7] A tooth can be completely intruded when it is completely embedded in the surrounding tissues, or partially intruded when the incisal edge of the crown is visible. The apex of the root is sometimes directed toward the permanent tooth bud or (more often) labially with or without fracture of the labial bone plate. The intruded primary incisor will in most cases re-erupt within 1-6 months without any pathologic sequences.[1,2,6] Complications associated with intrusion may affect the injured teeth or their permanent successors. Pulp necrosis, periapical inflammation, external root resorption, ankylosis, pulp canal obliteration (PCO), and fusion with the crown of the permanent tooth bud, were all mentioned as sequelae following intrusion.[8] The effect of intrusive luxation of primary incisors on the permanent successor has been widely investigated and reported in the literature.[1,9,10] However, except for some limited data[6] no publications were found in the literature that report on the prognosis of intruded primary incisors. The purpose of this retrospective study was to analyze the major characteristics, the prognosis and sequelae of intrusion of primary incisors.

Methods

The target population were children who sought treatment for intrusion of maxillary primary incisors at the emergency clinic of the Hebrew University-Hadassah School of Dental Medicine in Jerusalem, Israel, between May 1991 and December 1996. Of 218 files of children with intruded primary incisors, 22 files could not be traced leaving a group of 196 children. Required data was retrieved from files of children who allowed at least 12 months of follow-up after the initial visit. When data was missing or children did not return for the 12 month follow-up examination, an invitation letter was sent. Non-respondents were again invited by telephone.

Eighty-six children who did not show for the follow-up examination even after a telephone call comprised the non-respondents group. The other 110 children comprised the study group.

Basic data on the children and the injury were collected from the files of children of both groups. The data included demographic details, age at time of injury, type of teeth intruded, degree of intrusion (complete or partial), direction of the apex (labial, palatal), fracture of labial bone plate (yes, no), and antibiotic prescription provided (yes, no). Direction of the apex was determined by one or more of the following signs:

- inclination of the crown
- palpation of the soft tissue above the affected teeth
- presence of submucosal hemorrhage
- imaging of the teeth in periapical and lateral extra-oral radiographs.

The lateral extra-oral radiograph was used to determine fracture of the labial bone plate.

The following parameters were checked at the follow-up examination:

- repeated traumatic injury experienced since the intrusion
- pulpectomy and root canal filling to the injured tooth

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Table 1. Teeth with Partial or Complete Intrusion in the Study and Non-respondent Groups

Degree of intrusion	Study N=172	Non-respondents N=138	Total N=310
Partial	46%	54%	58%
Complete	69%*	31%*	39%
Unknown	67%	33%	3%
Total	55%	45%	100%

*Significant difference ($P<0.005$).

- extraction
- degree of re-eruption (fully or only partially)
- tooth position after re-erupted (normal or ectopic).

The teeth were clinically evaluated for increased mobility, sensitivity to percussion, sound produced during percussion (dull, normal, or metallic), and discoloration (type of color change). Periapical radiographs were exposed and evaluated for external and internal root resorption, periapical radiolucency, expansion of the periodontal ligament, arrest of dentin apposition, and pulp canal obliteration. The reason in case of extraction (e.g. pushed against the permanent tooth, periodontal breakdown) or tooth loss (avulsion due to repeated trauma) was also recorded. Periodontal breakdown was defined as the condition in which teeth present sensitivity to percussion, increased mobility, and expansion of the periodontal ligament with or without external root resorption.

In order to evaluate the influence of age on various factors associated with intrusion, the children were assigned to one of three groups (12-23 months, 24-35 months and 36 months or more) depending on the age they experienced the injury. Data were statistically analyzed using the χ^2 test. The Fisher Exact test was used when χ^2 test was not suitable.

Results

Characteristcs of intrusion of primary incisors

The age of the children at time of injury ranged between 12 and 72 months with a mean of 28 months and median of 25 months. The distribution of age in the non-respondents group was similar to that of the study group.

Boys experienced intrusive luxation more than girls (63% and 37% respectively; ratio 1.7:1). Sixty-four percent of girls returned for the follow-up examination compared to 36% in the non-respondents group; however, this difference was not statistically significant. The boy/girl ratio in the 2-, 3-, and 4-year-old children was 1.6:1, 1.6:1, and 1.7:1, respectively, with no significant difference between the groups.

Fifty-seven percent (111/196) of all children had only one intruded maxillary primary incisor each, 34% (66/196) had two intruded teeth each, 4% (9/196) had three affected teeth, and 5% (10/196) of the children had intrusive luxation of all four maxillary primary incisors. No significant difference was found between the study and the non-respondents groups.

Table 1 shows that 58% (180/310) of the teeth were only partially intruded and 39% were completely intruded. In the study group, however, 69% of the teeth examined were initially completely intruded compared to only 31% in the non-respondents group. This difference was significant ($P<0.005$).

Table 2. Survival Rates of Intruded Primary Incisors at Different Follow-up Periods

Follow-up time after injury (month)	Extracted teeth N	Survival rate N	%
Initial visit	23	149*	100
1-6	15	134	89
7-12	5	129	87
13-24	17	112	75
25-36	7	105	70
>36	4	101	68

*Number of teeth available for follow-up evaluation.

The apices of more than 80% of the 310 intruded teeth were pushed labially, with no significant difference between the study and the non-respondents groups.

Survival rates and extraction

Nineteen of 310 intruded teeth were suspected of being pushed against the bud of the permanent successor and were referred for extraction at the initial visit. Four additional teeth were extracted at the initial visit due to sever caries lesions leaving a total of 149 teeth for follow-up evaluation. Table 2 shows the survival rate of these teeth after different follow-up periods. Sixty-eight percent (101/149) of the intruded teeth survived more than 36 months after the injury. Indications for extraction of intruded primary teeth after a follow-up period periodontal breakdown (27%; 40/149) and repeated trauma (5%; 8/149). Of the 40 teeth extracted due to periodontal breakdown, 63% (25) were completely intruded at the initial injury and 37% (15) were only partially intruded. This difference was significant ($P<0.05$). Fracture of the labial bone during intrusion was not found to have any effect on loss of teeth due to periodontal breakdown.

Analysis of sequelae of intrusion in the study group

Follow-up time ranged between 0 and 59 months. The mean follow-up time (excluding immediately extracted teeth) was 27 months.

Fig 1. Clinical view of a maxillary primary incisor with its labial surface facing the palate. The tooth was twisted 90 degrees during intrusion and another 90 degrees of rotation in the same direction during re-eruption.

Table 3. Degree and Direction of Re-eruption of Teeth With or Without Fracture of the Labial Bone Plate in the Study Group

Fracture of labial bone plate	Degree of re-eruption Full N=109	Partial N=12	None N=2	Tooth position after re-eruption Normal N=76	Ectopic N=45
Yes	90%	8%	2%	60%	40%
No	86%	14%	0%	65%	35%
Unknown	92%	4%	4%	64%	36%
Total	88%	10%	2%	63%	37%

Mean follow-up time 27 months. No significant difference (P>0.05).

Table 4. Re-eruption of Partially and Completely Intruded Teeth in the Study Group

Degree of intrusion	Degree of re-eruption Full N=109	Partial N=12	None N=2	Tooth position after re-eruption Normal N=76	Ectopic N=45
Partial (N=64)	92%	8%	0%	70%	30%
Complete (N=58)	84%	12%	4%	55%·	45%·
Unknown (N=1)	100%	0%	0%	0%	100%
Total (N=123)	88%	10%	2%	63%	37%

· Two teeth failed to re-erupt. Mean follow-up time 27 months. No significant difference (P>0.05).

One hundred and twenty three teeth were available for the follow up evaluation of re-eruption. Of these, 88% (109) re-erupted fully, 10% (12) did not return to the occlusal plane, and 2% (2) failed to re-erupt due to ankylosis diagnosed by firm stability and metallic sound produced by percussion. Failure to re-erupt to the occlusal plane was often associated with pacifier or thumb sucking or tongue thrust. These teeth, however, did not present more clinical or radiographic pathologic signs than the fully re-erupted teeth. Fracture of the labial bone during intrusion was not a significant factor influencing the ability of the teeth to re-erupt and their position after re-eruption (Table 3). Teeth re-erupted back to normal position in 63% of the cases, while ectopic positions of the teeth were observed in 37% of the teeth (Table 3). Re-eruption into an ectopic position was observed more often in children injured at age 24-35 months. The major ectopic position was found to be rotation of the teeth along their long axis. One of the teeth had been twisted 90 degrees during intrusion and while re-erupting rotated an additional 90 degrees ending its full eruption with its labial aspect facing the palate (Figure 1). In another case, intrusion occurred before eruption of the canines. This tooth lost its space due to mesial drift of adjacent incisors probably pushed by the erupting canines (Figure 2). Rotated teeth did not present more clinical or radiographic pathologic signs than the teeth that returned to their normal position.

Full re-eruption occurred in 84% (49) of the teeth that were completely intruded compared to 92% (59) of the teeth that were only partially intruded (Table 4). Two completely intruded teeth became ankylosed and failed to re-erupt. The degree of intrusion was not a significant factor influencing the ability of the teeth to re-erupt. Ectopic position was observed in 45% (25) of the completely intruded teeth compared to 30% (19) of those only partially intruded (Table 4). The degree of intrusion was not a significant factor influencing the position of the teeth after re-eruption.

Of 123 teeth evaluated for re-eruption two teeth failed to re-erupt leaving 121 teeth for radiographic evaluation of the appearance of the pulp (Table 5). Thirty-three percent (38) of these presented normal pulp and 52% (58) presented PCO. PCO was more likely to occur in teeth which were completely intruded 64% (33) when compared to those only partially intruded 40% (24) P=0.006. There was a significant difference in the occurrence of PCO as a function of age (P=0.006) (Table 6). There was a higher occurrence of PCO in children of the younger (66%) and older (82%) age groups when compared to the middle age group (31%).

Sixty-three percent (76/121) of the re-erupted teeth presented coronal discoloration with the most common types being yellow (55/76) followed by gray (17/76), pink (2/76), and a brownish hue (2/76). Forty of the 55 teeth with yellow discoloration presented PCO in association with color change.

Eighteen percent (9/17) of the completely intruded teeth presented arrest of dentin apposition compared to 14% (8/17) of the partially intruded teeth (Table 5). Seven teeth presented internal resorption, six of which were extracted due to additional pathologies and one tooth was treated endodontically and saved. Endodontic treatment had been performed in six teeth with a pulp suspected of being necrotic. Five of these teeth survived and one was later extracted due to periodontal breakdown.

Antibiotic therapy prescribed at the emergency visit did not have any effect on survival rate and loss of teeth due to periodontal breakdown (Table 7). Cases in which patients did or did not receive antibiotic therapy at their initial visit were ana-

Fig 2. Clinical view of incomplete re-eruption of a maxillary primary incisor intrusion. The maxillary canines erupted after intrusion and before re-eruption of the intruded incisor causing loss of space, ectopic and incomplete re-eruption of the incisor.

Table 5. Radiographic Appearance of the Pulp of Re-erupted Teeth as Function of Degree of Intrusion

Degree of intrusion	Radiographic appearance of the pulp: Normal appearance N=38	Pulp canal obliteration N=58	Arrest of dentin apposition N=17	Total N=113*
Partial (N=59)	46%	40%	14%	100%
Complete (N=53)	18%	64%	18%	100%
Unknown (N=1)	0%	2%	0%	100%

*Some cases did not have radiographs for evaluation. Mean follow-up time 27 months. No significant difference (P>0.05).

lyzed in regard to the severity of the injury (i.e. degree of intrusion and labial bone fracture). No associations were found between the severity of intrusion and antibiotic therapy (P>0.05).

Dental history revealed that 10% (N=18) of the teeth suffered from previous injury. Of these, 39% were extracted due to periodontal breakdown compared to 21% (32 teeth) of the teeth with no previous injury. This difference was not statistically significant (P>0.05).

Analysis of age in the study group

Table 6 shows the distribution of the intruded incisors by various aspects (degree of intrusion, root displacement, and labial bone fracture) at three age groups. There was a reduction in the tendency of incisor teeth to be completely intruded as the children grew older. This difference, however, was not significant. There was a higher experience of labially displaced roots in the 24-to 35-month-old children than in the younger age group. This was again reversed to a lower percentage of labially displaced roots in children aged 36 months or more. This difference was found to be significant (P<0.008).

There was no influence of the child's age at time of injury on the degree of re-eruption. However, significantly more teeth presented ectopic position in three-year-olds compared to four-year-old children (P=0.002). There was a significant difference between the distribution of teeth with various pulp conditions after re-eruption at age two and age three (P= 0.0002) and between age three and four (P=0.06) (Table 8).

Discussion

This study presents the various characteristics of intrusive luxation of primary incisors and prognosis and sequelae to the injured teeth. As a retrospective study, it has several drawbacks. The children were examined and treated by a number of clinicians who diagnosed and made their individual decision which was not based on established protocols.

In this as in many other studies, boys had experienced more traumatic injuries than girls.[5,11,12] Compliance was only 51% of the injured children, however, the study group differed from the non-respondents group in only two characteristics. The percentages of girls and completely intruded teeth were higher in the study group. This can be explained by a higher concern of parents to the appearance of their daughters and to more severe injuries.

The apices of more than 80% of the teeth were pushed labially. However, analysis of root displacement at the different age groups (Table 5) showed that the 24- to 36-month-olds experienced labially displaced roots more than the younger and older age groups. The traditional explanation for the high incidence of labial displacement of the root apex during intrusion of primary incisors refers to the labial curvature of the root apex.[1] This may apply to intrusion of mature teeth with fully developed roots. In the young age group, some teeth were injured before completion of root development and apical closure and in the older age teeth were intruded when the curved apex had been resorbed already as part of the physiologic process.

An interesting observation was the condition of the pulp after intrusion. While over 90% of permanent teeth lose the vitality of the pulp after they are intruded,[1] it is not a common consequence in intruded primary incisors. PCO was the most common response of the pulp found in 52% of re-erupted teeth. An even more surprising finding is the significant correlation between complete intrusion and PCO. The analysis of pulp response at different age groups showed that the highest degrees of PCO were observed in 12-23 and >36- month-olds. At these ages, the apex may be open (either not yet closed or already resorbed) allowing re-vascularization of the pulp and apposition of calcified deposits. Some teeth with arrest of dentin apposition were left untreated as there were no other accompanying pathologic signs, while other (suspected of being non-vital) were treated endodontically.

An intruded primary incisor is indicated for extraction when it is suspected to inflict damage to the developing permanent tooth bud. In other cases, the intruded tooth can be left untouched and is expected to re-erupt spontaneously. However, leaving an intruded incisor for spontaneous re-eruption does not assure complete recovery. The present study showed that

Table 6. Characteristics of Intruded Primary Incisors in Different Age Groups

Age groups (in months)	Number of children	Number of teeth	Degree of intrusion*: partial N=180	complete N=121	Root direction**: labial N=249	palatal N=22	Labial bone fracture†: yes N=163	no N=98
12-23	79%	119%	58%	42%	91%	9%	59%	41%
24-35	71%	125%	60%	40%	96%	4%	64%	36%
> 36	44%	66%	62%	38%	85%	15%	64%	36%
Total	196	310	60%	40%	92%	8%	62%	38%

*no data for nine teeth. **no data for 39 teeth. †no data for 49 teeth. Mean follow-up time 27 months. No significant difference (P>0.05).

27% of the teeth left for follow-up evaluation had developed late complications that indicated extraction.

One of the most severe complications of an injury is infection.[1] The supporting apparatus of a healthy tooth is protected by the attached gingiva against invasion of oral microorganisms. As the tooth is pushed into the tissues, rupture of this attachment is unavoidable. Oral bacteria may now infiltrate and infect the wounded tissues. It has been shown in the present study that antibiotic therapy did not reduce the number of teeth extracted due to periodontal breakdown. One may claim that antibiotic therapy has been provided to the more severe cases of intrusion. This assumption was rejected when analysis disclosed no significant differences between the cases of complete intrusion and fracture of the labial bone plate (as indicators of more severe injuries) and antibiotic administration. As there is no definite policy for antibiotic therapy in cases of traumatic injury to the primary teeth, decision is made by the clinician based on his/her own experience. Lack of such a policy also resulted in a variety of drugs prescribed, even though, in most cases amoxycillin was the drug of choice. A culture and sensitivity test in such cases is not relevant as infection may spread before laboratory findings are accepted. Adult patients are encouraged to rinse their mouth with a chlorhexidine preparation when reduction of oral bacteria is required.[13] This is not practical in 2- to 4-year olds who are unable to gargle effectively and may swallow the fluid. It is the parents' responsibility to brush their child's teeth and cleanse the gingival crevice surrounding the affected tooth with a chlorhexidine-soaked applicator. The background of periodontal breakdown is not always limited to damage to and infection of the periodontal ligament . Experiments in replantation of permanent teeth showed that a necrotic pulp plays an important role in the development of external root resorption in cases of injury to the periodontal ligament.[13,14] Removal of the pulp when suspected of being necrotic may improve the prognosis of intruded primary incisors. It is difficult, however, to determine at an early stage whether or not endodontic treatment is necessary as more than half of the intruded primary teeth preserve their vitality.

Andreasen and Andreasen[1] mentioned inflammation around the intruded primary tooth accompanied by swelling of the gingivae and oozing of pus from the gingival crevice as possible complications during the re-eruption phase. They recommend immediate extraction and antibiotic therapy for such conditions. It seems, however, that in some cases extraction may be prevented if the pediatric dentist adopts a more active approach performing endodontic treatment when found necessary and considers antibiotic therapy starting at the initial visit and instructs the parents to keep good oral hygiene. It is the pediatric dentists' responsibility to do everything possible to save the primary tooth, as long as there is no risk to the permanent successor.

Table 7. Distribution of Extracted Teeth With or Without Antibiotic Therapy

Antibiotic therapy	No extraction N=100	Extraction due to PDL breakdown N=40	Extracted for other reasons N=32
Yes (N=68)	54%	31%	15%
No (N=103)	61%	18%	21%
Unknown (N=1)	0%	100%	0%
Total (N=172)	58%	23%	19%

Mean follow-up time 27 months. No significant difference ($P>0.05$).

Conclusions

1. After more than 36 months of follow-up the survival rate of intruded teeth that were not extracted at the initial visit was 68%.
2. Full re-eruption is anticipated in 88% of intruded primary teeth.
3. Ectopic position (mostly rotation) of teeth is a common outcome following re-eruption.
4. Habits such as pacifier or thumb sucking may avoid full re-eruption.
5. Systemic antibiotic therapy does not seem to affect the survival rate of intruded primary teeth and in some cases endodontic treatment is required.
6. Pulp canal obliteration is a common sequela following intrusion of primary incisors.

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Table 8. Analysis of Re-eruption Position, Degree of Re-eruption and Pulp Condition as a Function of Age Groups

Age groups (in months)	Crown Position Normal N=76	Crown Position Ectopic N=45	Degree of re-eruption Full N=109	Degree of re-eruption Partial N=12	Degree of re-eruption None N=2	Pulp condition Obliteration N=58	Pulp condition Arrest of dentin apposition N=17	Pulp condition Normal N=38
12-23 (N=57)	66%	34%	86%	12%	2%	66•%	18%	16%
24-35 (N=51)	52•%	48%	90%	8%	2%	31•%	15%	54%
> 36 (N=15)	87•%	13%	93%	7%	0%	82%	0%	18%
Total (N=123)	63%	37%	88%	10%	2%	52%	15%	33%

•Significant difference ($P<0.005$). Mean follow-up time 27 months.

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Abstract of the Scientific Literature

Head Posture and Malocclusions

This study determined if there is a relationship between head and neck posture and malocclusion. Forty-five male and fifty-one female caucasian children aged 7-13 years who presented for orthodontic treatment were studied. Cephalometric tracings were used to describe both malocclusion and head posture. Space anomalies, describing both crowding and spacing, were recorded. The results showed that "lack of space in the dental arches was associated with an increase in the craniocervical angulation." Therefore, in this study, it appears that dental crowding may be associated with craniocervical posture.

Comments: None of the subjects in this study had a diagnosed craniofacial anomaly or symptoms of upper airway obstruction. JEP

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Head posture and malocclusions. Solow B, Sonnesen L. European J. Ortho 20:685-693, 1998.

Abstract of the Scientific Literature

Pacifier Sucking and the Nursing Bottle as Risk Factors for Caries

Previous work by these authors on a cohort of' 166 children (age range 0.7-4.4 years) attending 11 day care centers in the City of Oulu, Finland, showed that the use of a pacifier and night nursing bottle increased the occurrence of salivary caries-associated microorganisms, lactobacilli, and candida. In the present study, these children (88 boys, 78 girls age range 2.7-6.5 years) were followed for two years and the progression of both initial caries and manifest caries (lesions which had extended to dentin and needed restoration) were recorded at annual dental examinations. A total of 79% had used a pacifier and 59% had used a night nursing bottle. Stepwise logistic multivariate modeling was used to control for confounding variables. Significant factors for caries development were prolonged pacifier-sucking (24 months or longer), with a rather high relative risk ratio (RR=3.5, 95% confidence interval=1.5-8.2, *P*=0.003); and prolonged use of a night nursing bottle (24 months or longer) with a lower relative risk ratio (RR=2.6, 95% confidence interval=1.1-6.4, *P*=0,03). Breast-feeding was not significantly associated with caries development.

Comments: Although a cause and effect relationship between prolonged pacifier usage, prolonged night nursing bottle usage, and the development of dental caries in very young children has not been shown in this study, these must be recognized as possible risk factors. Of interest, the study does not address whether the pacifier was used with or without an additive. LBM

No reprints available.

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