Conservative Treatment of Traumatic Intrusion of Permanent Incisors with Incomplete Root Formation*

Determining treatment in cases of post-traumatic intrusion of teeth depends on the depth of intrusion and stage of root development. In three patients, at age 7, 8.5 and 9, re-eruption of intruded teeth was observed. The state of the teeth was estimated by X-ray and LDF (Periflux 5010®). In a boy aged 9, using the initials B.L. as an identifier, incisor 11 with an incomplete root formation was intruded to a depth of 5 mm. After 1.5 months it returned to its primary position however an inflammatory external resorption of the root was observed. Period of observation: 5 years. In a girl aged 8.5, A.M., tooth 21 was observed to intrude more than 5 mm. After 6 months, it returned to its primary position, the pulpal blood flow remained normal. Period of observation: 6 months. The treatment of traumatic intrusion of permanent incisors with incomplete root formation is based on observations of spontaneous re-eruption. During the healing process, correct radiological observation and the control of dental pulp vitality is needed (Dent. Med. Probl. 2012, 49, 2, 309–316).

Key words: tooth intrusion, incomplete roots formation.

In the population of school children in Łódź, the prevalence of traumatic injuries is estimated at 2.32%. Most often, the upper central incisors in children aged between 7 and 10 years are involved, before root development has finished [1].

One of the less common types of dental trauma of permanent teeth is an intrusion into the alveolar bone, which most often happens as a result of the action of considerable, direct forces. This type of injury more often happens in primary than permanent dentition. According to Andreasen et al. [2], patients with intruded permanent incisors represent 1.9% of those visiting their dentist because of dental trauma. Thanks to the great...
controversy surrounding the treatment of intruded teeth and the relatively small number of cases presented in contemporary literature, the presentation of each case is of great value.

Dental treatment and prognosis in such types of dental trauma depends on many different factors: depth of intrusion, direction of tooth dislocation, state of development of root apex, number of teeth involved in intrusion, age and general state of the health of the child, time that passed between the accident and arrival to the dental surgery.

Intrusion devastates the system of ligaments that keeps a tooth in the alveolar socket and not only leads to the destruction of tissues surrounding the root, but also often to the breakage of the neurovascular bundle. As a consequence, this may lead to the atrophy of cells of the root cement, which may further lead to various complications such as external resorption or ankylosis of the root.

The aim of the study was the evaluation of the efficacy of conservative treatment of intruded permanent upper incisors with incomplete root formation.

In three patients at developmental age (7, 8.5 and 9), two girls and one boy, a treatment was performed based on observation of the spontaneous re-eruption of intruded teeth after a mechanical injury.

The teeth were under radiological observation, while the vitality of pulp was tested with the use of ethyl chloride and a Perilux System 5010® Laser Doppler Flowmetry device (LDF). The levels of blood flow were compared with the mean data estimated for a certain age and tooth group, gained through previous studies which were performed in the Department of Pediatric Dentistry in Łódź (Table 1) [3].

### Case Reports

#### Case 1

A boy, using the initials B.L. as an identifier, aged 9, entered the Department of Pediatric Dentistry on 22.08.2005, with a dental trauma of teeth 11 and 21, which had taken place on 15.08.2005 in a children’s playground when the boy had fallen from a swing. In a clinical examination, it could be seen that tooth 11 intruded into the tissues to a depth of more than 5 mm, with a fracture of enamel and dentine, with no pulp exposure. Based on an interview and comparison of two radiographs taken in a private surgery, one on the day of the accident and the other on the day of arrival, it was found that the tooth had already started re-eruption and had moved 2–3 mm during the recent week (Fig. 1 a, b). Tooth 21 was partially luxated, with 1st grade mobility. The roots of teeth 11 and 21 were incomplete. It was decided that tooth 11 was to be observed for further spontaneous eruption. There was no reaction to cold stimuli in both teeth. On the day of arrival, the fracture line was covered with a composite material and proper hygiene and soft diet were advised.

Tooth 11 returned to its proper position 1.5 months after the injury. During subsequent visits, the teeth still did not react to cold stimuli, hence, it was decided to measure the blood flow in the dental pulp. This was performed with the Perilux 5010® LDF system.

Two weeks after the first arrival of the patient to the Department, the blood flow was measured in the affected teeth: tooth 11 – 3.57 ± 0.36; tooth 21 – 6.27 ± 3.54; tooth 22 – 8.05 ± 0.69. Control estimations of levels of blood flows were made in lower antagonist teeth: tooth 42 – 5.3 ± 0.90; tooth

#### Table 1

<table>
<thead>
<tr>
<th>Age  – years (Wiek – lata)</th>
<th>Tooth 11 (mean ± SD)</th>
<th>Tooth 21 (mean ± SD)</th>
<th>Tooth 41 (mean ± SD)</th>
<th>Tooth 31 (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7–8</td>
<td>7.94 ± 3.55</td>
<td>9.79 ± 3.85</td>
<td>14.09 ± 5.96</td>
<td>16.38 ± 5.78</td>
</tr>
<tr>
<td>9–10</td>
<td>9.89 ± 4.79</td>
<td>10.48 ± 5.60</td>
<td>14.33 ± 5.93</td>
<td>15.49 ± 6.3</td>
</tr>
</tbody>
</table>

![Fig. 1. Patient B.L., age 9, an X-ray of teeth 11 and 21, at the day of trauma (a) and one week after (b)](image-url)
Traumatic intrusion of Permanent incisors

41 – 3.63 ± 0.56; tooth 31 – 9.3 ± 0.63 and tooth 32 – 4.98 ± 0.72.

The results received from tooth 11 were interpreted as uncertain. A repeat estimation of pulpal blood flow was planned for the following two weeks, however, the patient did not come.

In light of the above, and the presence of the external resorption of the root of tooth 11 seen on the X-ray, it was decided to perform an extirpation of the pulp. The removed pulp was in a state of purulent necrosis. After 5 months of apexification with calcium hydroxide paste (Calasept, Nordic®), the beginning of a total mineralized barrier was noticed on the root apex, at a distance of 17 mm from the incisal edge (Fig. 2). At the same time, the resorption process slowed down. Thirteen months from the injury, a total mineralized barrier was found on the top of the root. Eventually the root canal was obturated with flow gutta-percha (Obtura II system) and sealed with AH Plus paste (Dentsply®).

In adjacent tooth 21, regular root development was observed with a narrowing of canal width. After a year, advanced obliteration of the root canal was present, so the decision to extirpate and perform root canal treatment was taken to prevent total obliteration. Under local anesthesia, the pulp was extirpated and the canal was obturated by lateral condensation; cold gutta-percha was sealed with AH Plus paste. Follow-up observations during the subsequent 4 years revealed that the process of resorption in tooth 11 had stopped (Fig. 3).

**Case 2**

A girl, P.M., aged 7, was registered in the Department of Pediatric Dentistry on 19.06.2007, after a dental trauma. The accident had happened one week before, while racing a Go-Kart. The patient had hit the steering wheel with her head during a head-on collision of cars. After the accident, no loss of consciousness or any other general complaint was reported.

In a clinical examination, subluxation of tooth 11 was found and tooth 21 was intruded by a depth of 4–5 mm. Also, in the area of tooth 21, a fractured piece of bone lamina was found in the gingiva (Figs. 4–6).

In the lower jaw, the crowns of teeth 31 and 41 were found to be fractured, involving enamel and the dentine but with no pulp exposure. Under local anesthesia, the bone fragment was removed and...
cosmetic reconstruction of the crowns for teeth 31 and 41 was performed. Radiological observations revealed no pathological changes; the roots of teeth 11 and 21 were not completely formed.

Conservative treatment was decided, based on the observation of the movement of the teeth. During follow-up visits, teeth 21, 11, 31 and 41 were found to have normal reactions to cold stimuli.

After a month, tooth 21 erupted by about 2 mm, and over the following 5 months, it returned to the proper position compared with the adjacent tooth. During a 2-year observation, no pathological symptoms were observed while proper physiological root formation took place in teeth 11 and 21, as well as 31 and 41 (Figs. 7–8).

**Case 3**

A girl, A.M, aged 8.5, was received in the Department of Pediatric Dentistry on 20.06.2010, a day after a trauma. The child had fallen off her
skateboard. On the day of arrival, an intrusion of tooth 21 to a depth of about 5 mm was found, subluxation and fracture of the enamel of tooth 11, as well as cuts and a swelling of the upper lip were present. The roots of the incisors were in the very early stage of development according to age norms. Stimulation with ethyl chloride showed a delayed pulp response in tooth 11 and lack of reaction in tooth 21. The decision to observe was made, and an antibiotic cover (Dalacin C®) was prescribed. After a week, the tooth moved down by 2–3 mm, and after the next 5 months, the tooth reached normal length (Figs. 9–10). After re-eruption, the tooth was in a rotated position, as it was before the injury. In tooth 11, the reaction to cold stimulation was normal, while in tooth 21, there was no reaction.

To evaluate the vitality of the pulp, the teeth underwent Laser Doppler Flowmetry measurement. In the examination, normal blood flow rates were measured. In tooth 21, the flow reached 14.62 ± 0.04 PU, while it reached 15.48 ± 0.05 PU in tooth 11 (control). On an X-ray, no pathological changes were noticed (Figs. 11–12). The period of observation was 6 months.

**Discussion**

In one of the most extensive epidemiological studies, by Andreasen et al. [2], based on a 50 year observation of 151 patients with intruded permanent incisors, it was stated that in 33.5% of cases of intrusion, only one tooth was involved with no other complications, in 60.5% of cases, the intrusion was complicated with a fracture of the crown and in 6% there was either crown root fracture or root fracture. Most often, as seen in 46.3%, only
one tooth was intruded. However, two teeth were seen in 32.4%, and three or more in 21.3%.

Intrusion into the alveolar socket is one of the most serious dental injuries. The difficulties associated with accurate diagnosis and treatment of this kind of trauma is caused by a lack of unambiguous standards of treatment. In the case of intrusion, three possible courses of dental treatment exist: observation of the tooth for spontaneous re-eruption, immediate surgical repositioning of the tooth to a proper position, orthodontic repositioning with fixed appliances.

The divergence of treatment is of special importance in the treatment of immature teeth, in which the pulp has a much greater ability to heal compared with that of matured teeth.

Gondim et al. [4] used two different methods of treatment in two twin cases of intrusion of incisors with incomplete root formation, in two different patients at ages 7.5 and 8. In the first case, an immediate surgical reposition was performed while in the other, a conservative method based on observation of spontaneous re-eruption was employed. Both of the methods gave positive results in long-term observation; the vitality of pulps was retained and the process of the root apex were completed. Surgical reposition is unequivocally indicated only in the case of really deep intrusion e.g. into the nasal cavity [5].

Some authors recommend applying an orthodontic repositioning as it has the smallest percentage of post injury complications. On the basis of literature data and their own observations, Chauushu et al. [6] estimate that in orthodontic repositioning of intruded teeth, the primary position of the teeth was regained in 90% of cases in a group of 31 teeth.

All of the teeth with completed root development and 50% of teeth with immature roots underwent endodontic treatment. Nevertheless, external resorption was present in half of the cases. Most authors recommend a conservative approach in cases of teeth with incomplete root formation and intrude to a depth of no more than 5–6 mm [7, 8].

Observing the eruption process of the tooth seemed to be the least traumatic method for patients and the capacity of a tooth to spontaneously re-erupt seems to be significant. Schott et al. [9] describe a case of the re-eruption of a tooth 15 years after injury. In a group of 51 intruded teeth treated by Wigen et al. [10], spontaneous eruption was noticed in 35 of them. Moreover, the authors found that the prevalence of external resorption was significantly lower in the group of teeth left for eruption than in the group treated with surgical or orthodontic methods.

On the other hand, conservative treatment demands close cooperation between dentist and patient, and the success of treatment depends on proper observation of the state of the pulp and surrounding tissues. Up until now, the vitality of the pulp could be estimated by three methods: reaction to cold stimuli with ethyl chloride, electric stimulation and assessment of pulpal blood flow. In teeth with incomplete root formation, the method based on electric stimulation has limited diagnostic value. In an investigation performed in the Pediatric Department of Łódź, it was found that in half of sound teeth with incomplete roots in children aged 9–12, the pulp does not respond properly during electric stimulation [11]. Still, the most common way to estimate the vitality of tooth pulp remains the reaction to cold stimuli with ethyl chloride. However, both reactions to cold and electric stimuli, are based on nerve conduction.

In the present study, the period of observation associated with the girl aged 8.5 (patient 3) was the shortest of all. Although the pulp did not initially react to cold stimuli, the blood flow in the intruded tooth 5 months after injury was on a comparable level to that of a control adjusted tooth. Even when taking into account the problem of subjectivity in assessing vitality in young children, it is commonly known that the reaction of nerve fibers is somehow decreased, even in the presence of proper blood circulation. On the other hand, estimation of pulpal blood flow allows for very early detection of disturbances in blood circulation in the pulp and subsequent necrosis, and for deciding the course of endodontic treatment before radiological and clinical complications appear.

During the evaluation of blood flow in luxated teeth, it has been observed that the return to normal levels depends on the age of the patient and the stage of root apex development. A return took place 3–4 weeks after injury in children 7–8 years old, and 6 to 8 weeks in children 9–12 years old [12].

It has also been observed that, after fixation of teeth with orthodontic appliances, the interim rate of blood flow can drop to even half of the initial value [13]. Such a great decrease of pulpal blood flow can be another argument for the conservative treatment of intruded teeth.

In the case of the 9-year-old boy (patient 1), necrosis of the pulp occurred in intruded tooth 11 as a result of the trauma. This child was the oldest among all the observed ones, so the development of the tooth roots was most advanced and was additionally complicated by the fracture of the enamel and dentine of the crown. In this case, external resorption had developed and root canal therapy was needed. Starting the treatment at the correct time made it possible to stop the process.
Conclusions

The treatment of traumatic intrusion of permanent incisors with incomplete root formation, in most cases, is based on observation of spontaneous re-eruption. During the healing process, a correct radiological observation is needed and monitoring dental pulp vitality is crucial.

References


Address for correspondence:

Patrycja Proc
Dental Institute, Clinical Hospital No 6
Pomorska 251
92-213 Łódź
Poland
tel./fax: +48 42 6757516
E-mail: patrycja.proc@umed.lodz.pl

Revised: 10.05.2012     Po recenzji: 10.05.2012 r.
Accepted: 18.05.2012     Zaakceptowano do druku: 18.05.2012 r.