# Federal University of Santa Catarina follow-up management routine for traumatized primary teeth – part 1

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Abstract – The objective of this study was to verify if the follow-up management routine of traumatized primary teeth set up by Federal University of Santa Catarina, which performs clinical and radiographic assessments (15 and 45 days; 4, 8 and 12 months) after the oral trauma, enabled an early diagnosis of sequelae which would indicate the need for endodontic intervention, as well as the influence a type of trauma and the child's age could have in the severity of the sequelae. In this study 52 sets of records were used of patients being seen in the last 6 months, with a total of 70 teeth that were receiving follow-up treatment. Patients returned for regular visits set up by the management routine, where clinical and radiographic examinations were performed to check for sequelae, which justified endodontic intervention. Mobility (51.2%) and crown discoloration (25.6%) were the most common sequelae found in the patient's first appointment. In the follow-up visits, replacement root resorption (22.5%) was the second most common sequela found, suggesting endodontic intervention. No significant association was found between severe sequelae, types of trauma and a child's age ( $\chi^2 = 0.3$ , P = 0,8613). During the intervals of the follow-up visits, it was noticed that between 46 days and 8 months a higher number of sequelae were diagnosed (P < 0.05). The diagnosis of sequelae such inflammatory and replacement root resorption, which can lead to an early loss of a primary tooth, are frequent and that the interval between the follow-up visits has to be changed, suggesting the setting up of management routine 2. The study also concluded that the type of trauma and the child's age are not fundamental factors in the diagnosis of severe sequelae.

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In the seventies, many scientific studies were published with the aim of guiding clinicians to deal with primary teeth injuries, as the literature about the subject was scarce because of the fact that these oral traumas were not regularly reported (1). Nowadays, despite the fact that epidemiological studies show a high incidence and prevalence of trauma in children (2-8), specifically in the 0- to 4year-old group, the injuries to primary teeth still receive little attention from researchers (4, 8).

Although the number of papers about this subject has increased, they consist mainly of reports of isolated clinical cases or theoretic arguments based on review of the literature, instead of controlled clinical research, laboratories studies (9) or longitudinal studies with significant samples (4).

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Research in the area of Pediatric Dentistry is often based on the empirism observed in certain types of treatment. However, the results of these researches could be scientifically questioned when taking into consideration the biological principles intrinsic to the primary and permanent dentition.

Traditionally, the long-term follow-up for primary teeth that suffered severe traumas is not considered relevant, as some authors believe that the primary incisors do not have a significant functional, phonetic and aesthetic role. However, the consequences of a premature loss of the primary incisors in the development and eruption of the future permanent successor are unpredictable (8).

The setting up of a management routine to make longitudinal follow-ups of the traumatized primary teeth, allows for a logical approach when deciding whether to keep or remove the affected tooth. An observational research can allow dentists to decide more clearly between the risk factors and benefits that the treatment will bring to the patient.

In order to be able to re-evaluate, question or promote changes, it is necessary to have longitudinal research that have as a starting point a population sample of children whose parents sought treatment. Thus allowing us to observe and treat these cases, following a treatment guide, adapted to children's realities, nevertheless based in scientific observations and findings from established management routines for the permanent dentition (10).

For such, the purpose of this study is to present a contemporary approach for the treatment of primary dental injuries that has been used by the Department of Paediatric Dentistry at the Federal University of Santa Catarina (UFSC)- Brazil, since August 1998. The aim of the study, through clinical and radiographic assessment, is to monitor traumatized primary teeth using early diagnosis of sequelae, as well as the planning and execution of endodontic therapy, with the purpose of keeping the tooth healthy during its biological cycle.

### **Methods and materials**

Since August 1998, 120 children are being seen by UFSC dental service. From these children, 52 patient's records, with a total of 98 traumatized teeth are receiving follow-up treatment or are being treated endodontically for a period of at least 6 months. They have been divided into two groups:

- **1** Consisting of 70 traumatized teeth that have received long-term follow-up treatment, but were not endodontically treated.
- **2** Consisting of 28 traumatized teeth that have received long-term follow-up treatment and have been endodontically treated.

UFSC's management of traumatized primary teeth receiving long-term follow-up control

The patients that suffered traumatic injuries to their primary teeth and sought treatment at the Pediatric Dental Clinic at the UFSC were seen according to the procedures of the university's management routine for the treatment of traumatized primary teeth, previously established by the Child Dentistry Department at the same University.

It is important to mention that all the patients included in this research, were seen by only one professional since the management routine was set up in August 1998. All the treatments started with the patient's case history, including personal information, the history of the injury, information about the present situation and patient's main complaint. Information regarding eating habits, oral hygiene, decay history and the presence of other harmful habits were also recorded.

After that, the parents or guardians received a consent form to be read and signed if they agreed with the procedures of the management routine. Following all the Pediatric Dentistry service procedures, the first clinical examination was performed, starting by examining the soft tissues (laceration, swelling and fistula) and evaluating tooth mobility, discoloration and sensitivity to percussion (the tone produced on percussion was also checked). After that, a radiographic exam was performed (70 kV with 0.2 s exposure), using radiographic devices (adult or infant dental films were used according to age), or by using Randall's technique (11) and, in cases of intrusion, lateral view radiography (70 kV with 0.8 s of exposure).

After the steps previously described, a diagnosis of the injured tooth was performed as per the Garcia-Godoy (12) classification:

- 1 Fracture: enamel crack and/or fracture, crown fracture with/without pulp exposure, crown-root fracture with/without pulp exposure and root fracture.
- **2** Luxation: concussion, subluxation, intrusion, extrusion, lateral luxation and avulsion.

When the child was not seen immediately after the injury, an assessment was made based on clinical and radiographic findings together with the information given by the parents in order to reach a correct diagnosis of the injury.

In the first visit, when it was noticed in clinical examination that a tooth presented mobility (mild or severe), the tooth was splinted with a semi-rigid splint (nylon wire 0.8 or steel wire 0.5). The time of the splinting depended on factors such as persistency of abnormal mobility, type of trauma, interference of eating habits and occurrence of a new trauma.

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# Treatment

The traumatized primary teeth which were not treated endodontically and received long-term follow-up treatment, were those that, despite the trauma, did not present clinical or radiographic signs that justified an endodontic intervention, such as: presence of fistula (a sign of pulp necrosis), replacement root resorption, inflammatory root resorption, internal root resorption and crown fracture with pulp exposure.

Teeth that did not need endodontic treatment received long-term follow-up with clinical and radiographic evaluations, following the management routine below, used for all kinds of injuries:

*First consultation*: clinical assessment and first radiographic exam;

Second consultation: 15 days after the injury, clinical and radiographic assessment;

*Third consultation*: 45 days after the injury, clinical and radiographic assessment;

*Fourth consultation*: 4 months after the injury, clinical and radiographic assessment;

- *Fifth consultation*: 8 months after the injury, clinical and radiographic assessment;
- Sixth consultation: 12 months after the injury, clinical and radiographic assessment;
- Seventh consultation onwards: clinical and radiographic assessment every 6 months until the eruption of the permanent successor teeth.

In every visit, a clinical assessment was performed observing the following aspects of the traumatized and adjacent teeth: crown discoloration, teeth mobility, horizontal and vertical percussion test (sensitivity and sound characteristics) and presence of fistula. Also, in every consultation, the child's supervisory adult was asked about further dental injuries, and in case of a positive answer, it was registered and emphasized in the Trauma's Assessment Form. Hygiene, diet and mouth cleaning routine were also stressed in every visit.

The radiographic exams previously described were performed following the same procedure of the first radiographic exam. Whenever possible, radiographic devices with adult or infant dental films (according to mouth size) were used, and when the child was not willing to cooperate, Randall's technique was used (11). In every radiographic exam, it was observed the signs for periapical inflammation, inflammatory or replacement root resorption, internal root resorption, root canal obliteration and root fractures. The adjacent teeth were also examined, as they usually suffer secondary traumas, and show negative sequelae.

# Results

The patients which had traumatized primary teeth and did not undergo endodontic treatment but received long-term follow-up, were registered with a number and after individual analysis of each tooth (clinical records and radiographs), some of the information was recorded in previously designed charts. The most relevant piece of information was used for the research. The data were evaluated and placed in (Tables 1–7), and statistically analyzed.

## Discussion

During the follow-up consultations, the number of teeth with severe mobility was reduced considerably. However, during the long-term follow-ups, the mobility appeared later (between 46 days and 4 months and between 9 and 12 months). This later appearance is probably related to the development of pathologic root resorption (Tables 2 and 4).

Crown discoloration was the second most common sequela, which appeared in higher numbers in diagnosis from the first visit (Table 1). During the long-term follow-up, it was noticed that the other teeth showed signs of discoloration and the alteration occurred soon after the trauma occurs 12 months after the accident in 40% of cases (Table 4). Results found by Borum and Andreasen (8) indicated that 53% of traumatized teeth showed crown discoloration. This study did not differentiate the discoloration, which can range from yellow to pink to gray. Regardless of this, the teeth always received long-term follow-up.

When in doubt about the pulpal death of gray discolored teeth, some authors (13, 14), and advocate root canal treatment or tooth extraction.

Table 1. Percentile and numerical distribution of the traumatized primary teeth in relation to the sequelae and type of trauma diagnosed during the first visit

		Тур					
Sequelae	RF	С	S	LL	I	Total	%
MO	3	2	13	2	2	22	51.2
CD	_	1	9	-	1	11	25.6
RCO	-	2	2	-	_	4	9.3
R	—	-	-	-	1	1	2.3
IRR	-	-	1	-	-	1	2.3
RRR	-	-	3	-	-	3	7
EL	-	-	-	1	-	1	2.3
Total	3	5	28	3	4	43	100
%	7	11.6	65.1	7	9.3	100	-

C, concussion; CD, crown discoloration; EL, earlier loss of the primary teeth; I, intrusion; IRR, inflammatory root resorption; LL, lateral luxation; MO, mobility; R, retention of the primary teeth; RCO, root canal obliteration; RF, root fracture; RRR, replacement root resorption; S, subluxation.

Table 2. Percentile and numerical distribution of the traumatized primary teeth in relation to the sequelae and time elapsed between occurrence of injury during the first visit

	Time elapsed between occurrence of injury and first visit							
Sequelae	Until 15 days [n (%)]	Between 16 and 45 days [n (%)]	Between 46 days and 4 months [n (%)]	Between 5 and 8 months [n (%)]	More than de 12 months [n (%)]	Total [n (%)]		
MO	13 (59.1)	5 (22.8)	1 (4.5)	1 (4.5)	2 (9.1)	22 (100)		
CD	2 (18.2)	2 (18.2)	<u> </u>	2 (18.2)	5 (45.4)	11 (100)		
RCO	-	-	_	-	4 (100)	4 (100)		
R	-	-			1 (100)	1 (100)		
IRR	1 (100)	-		-	-	1 (100)		
RRR	-	1 (33.3)		-	2 (66.7)	3 (100)		
EL	-	1 (100)	-	-		1 (100)		
Total	16 (37.2)	9 (21)	1 (2.3)	3 (6.9)	14 (32.6)	43 (100)		

CD, crown discoloration; EL, earlier loss of the primary teeth; IRR, inflammatory root resorption; MO, mobility; R, retention of the primary teeth; RCO, root canal obliteration; RRR, replacement root resorption.

Table 3. Percentile and numerical distribution of the traumatized primary teeth in relation to the sequelae and type of trauma diagnosed during the follow-up visits

			Туре	e of trau	trauma				
Sequelae	EF	RF	С	S	LL	1	A	Total	%
MO	-	-		3	-		-	3	7.5
CD	1	-	2	-	-	3	-	6	15
RCO	_		3	4	_	3	-	10	25
SL	-	-	-	-	-	-	2	2	5
FI	$\sim - 1$	-	1		$\sim$			1	2.5
AB	_	-		_	-	1		1	2.5
IR	-	-	1	—	-	-	-	1	2.5
IRR	$\sim - 1$	-	1	-	-	-	-	17	2.5
RRR	-	-	5	3	-	1		9	22.5
EL	-	3	-	1	1	1	-	6	15
Total	1	3	13	11	1	9	2	40	100
%	2.5	7.5	32.5	27.5	2.5	22.5	5	100	-

A, avulsion; AB, abscess; C, concussion; CD, crown discoloration; EF, enamel crack and/or fracture; EL, earlier loss of the primary teeth; FI, fistula; I, intrusion; IR, internal root resorption; IRR, inflammatory root resorption; LL, lateral luxation; MO, mobility; RCO, root canal obliteration; RF, root fracture; RRR, replacement root resorption; S, subluxation; SL, space loss. According to our management routine, this tooth must receive long-term follow-up, regardless of discoloration, and receive root canal treatment if any of the following alterations are diagnosed: internal root resorption, inflammatory or replacement root resorption, periapical inflammation or presence of fistula.

Another important factor was that discoloration was diagnosed in almost all types of trauma, ranging from mild (enamel cracks, concussion and subluxation) to more severe traumas such as lateral luxation, intrusion and avulsion (Table 3).

Root canal obliteration is also a common occurrence, which was diagnosed in the first exam and in the follow-up visits (Tables 3 and 4). It is possible to notice that canal obliteration diagnosis begins only between the period of 46 days and 4 months, becoming then more frequent, and might be diagnosed even up to 1 year after the injury (8, 15).

Contrary to inflammatory root resorption, which may be associated to fistula eruption and crown

Table 4. Percentile and numerical distribution of the traumatized primary teeth in relation to the sequelae and time elapsed between occurrence of injury during the follow-up visits

	Time elapsed between occurrence of injury and the follow-up visits							
Sequelae	Until 15 days [n (%)]	Between 16 and 45 days [n (%)]	Between 46 days and 4 months [n (%)]	Between 5 and 8 months [n (%)]	Between 9 and 12 months [n (%)]	More than 12 months [n (%)]	Total [n (%)]	
MO	-	-	1 (33.3)	-	-	2 (66.7)	3 (100)	
CD	1 (20)	-	2 (40)	-	_	2 (40)	5 (100)	
RCO	-	-	4 (36.4)	1 (9)	2 (18.2)	4 (36.4)	11 (100)	
SL	-	-	- ' '	-	1 (50)	1 (50)	2 (100)	
FI	-	-	-		-	1 (100)	1 (100)	
AB	-	1 (100)	-	-	_	-	1 (100)	
IR	-	-	-	-		1 (100)	1 (100)	
IRR	-	-	-	1 (100)	-	-	1 (100)	
RRR	—	-	1 (11.1)	-	2 (22.2)	6 (66.7)	9 (100)	
EL	-	5 (83.3)	1 (16.7)	-	- ` `	-	6 (100)	
Total	1 (2.5)	6 (15)	9 (22.5)	2 (5)	5 (12.5)	17 (42.5)	40 (100)	

AB, abscess; CD, crown discoloration; EL, earlier loss of the primary teeth; FI, fístula; IR, internal root resorption; IRR, inflammatory root resorption; MO, mobility; R, retention of the primary teeth; RCO, root canal obliteration; RRR, replacement root resorption; SL, space loss.

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Table 5. Association between the follow-up period for the traumatized primary teeth according to UFSC's management routine for diagnosis of severe sequelae through the proportion tests

Association	Significance level			
$A \times B/C/D$	P = 0.0206			
$A/B \times C/D$	not significant			
$A/B/C \times D$	not significant			

A, period until 45 days after the traumatism; B, period until 46 days and 8 months after the traumatism; C, period until 9 and 12 months after the traumatism; D, period superior than 12 months after the traumatism.

Table 6. Numerical distribution of the traumatized primary teeth in relation to risk factors and severe sequelae diagnosed applied to the chi-square test

Sequ			
Yes	No	Total	
7	17	24	
8	21	29	
3	5	8	
18	43	61	
	Yes 7 8 3 18	Sequelae   Yes No   7 17   8 21   3 5   18 43	

 $\chi^2 = 0.30 P = 0.8613 P < 0.05.$ 

Table 7. Associations between the presence and absence of risk factors through the chi-square test with *P*-value

Associations	$\chi^2$	Significance level (P)		
Absence of risk factors $ imes$ presence of risk factors	0.002	0.9624		
Severe trauma $\times$ mild trauma	0.66	0.4145		
Child's age below 3 $ imes$ child's age above 3	1.32	0.2506		

P < 0.05.

discoloration, replacement root resorption and internal root resorption occurs without clinical signs. Often when patients finally consult a pediatric dentist, because of an increase in the tooth mobility, the root has been almost entirely resorpted. This is where the follow-up visits from UFSC's management routine make the difference, as no clinical or radiographic alteration is needed for a dental follow-up assessment. Simply having a traumatized primary tooth is sufficient to receive long-term follow-up treatment, as the risk of damage to the primary and successor permanent teeth, may occur in the short, medium or long-term.

In the follow-up visits, the second most common sequela found was replacement root resorption (Table 3). It is important to stress that in the first visit, two cases of untreated resorptions are described (Table 1). This happened because of the impossibility in reaching the canal or the parent's refusal to allow the treatment. The diagnosis period for replacement root resorption was shown to be



Fig. 1. Patient PKC (1.5-years old) traumatized incisors superior (subluxation).



Fig. 2. Radiograph 19 months after the trauma.



Fig. 3. Radiograph 30 months after the trauma.



Fig. 4. Radiograph 37 months after the trauma. Observe the replacement root resorption.

between 46 days and 4 months, and after a year, the diagnosis represented 66.7% of pathologic root resorptions diagnosed in the follow-up visits (Figs 1–4). These resorptions occurred in mildly and severely traumatized primary teeth. These examples justify the long-term follow-up treatment, which was applied identically to each different kind of trauma and the period between follow-up treatments carried out by UFSC's management routine (Table 3).

It is possible to verify the presence of three cases of replacement root resorption and one case of inflammatory root resorption, which should have had endodontic treatment, as they did not fit the above requirements. The treatment was not performed as one of the cases of replacement root resorption happened in a mesiodens, while the other two were both associated with canal obliteration, not allowing an endodontic intervention. In the case of inflammatory root resorption, the tooth was extracted, as the resorption had destroyed more than two thirds of the root (Table 1).

UFSC's management routine offers a long-term routine follow-up procedure that bears no similarity to any other in dental literature. In this literature clinicians suggest intervals for new visits, but do not illustrate their explanations with real cases and therefore do not offer security for the pediatric dentist.

After implementing routine 1 for traumatized primary teeth follow-up visits, an assessment was made in order to decide if the intervals and the period that the return visits were proposed allowed for early diagnosis of post-traumatic complications. Associations between the different periods in which the management routine was implemented. Among the associations made, some were significant and others were not (Table 5). Interval 'B' (period between the 46 days and 8 months after the trauma) accounted for the difference between being significant or not among the associations. This suggests that the number of visits in this period must have smaller gaps between them. Another important piece of information in Table 5 shows that the period up to 45 days does not seem important in the diagnosis of severe sequelae. Taking this into account, a new proposal for follow-up visits has been put into practice, which will be part of UFSC's management routine 2:

- *First visit*: clinical assessment and first radiographic exam;
- Second visit: 30 days after the injury, clinical and radiographic assessment;
- *Third visit*: 90 days after the injury, clinical and radiographic assessment;
- Fourth visit: 5 months after the injury, clinical and radiographic assessment;
- *Fifth visit*: 8 months after the injury, clinical and radiographic assessment;
- Sixth visit: 12 months after the injury, clinical and radiographic assessment;

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*Seventh visit:* every 6 months, clinical and radiographic assessment until the eruption of the successor permanent teeth.

It is important to stress that the number of radiographic exams remains the same, only the visits are arranged differently.

When sequelae are diagnosed during the followup, the signs of severe sequelae (that lead to endodontic intervention) were associated with risk factors, that is, factors that made the teeth more liable to develop such sequela. The type of trauma was considered a risk factor and was divided in mild (crown fracture without pulp exposure, concussion and subluxation) and severe (lateral luxation and intrusion). The child's age at the moment of the trauma was also considered as a risk factor in a group of 3-year-olds. The choice of the age of three is justified by the quick recovery of the pulp tissue, which occurs in younger children because of the canal and apex length (13). The association between severe sequelae with no risk factors, the kind of trauma and the child's age showed that the presence of one or two risk factors is not linked to the presence of sequel during the follow-up (Table 6). This indicates that, regardless of the type of trauma or child's age, the follow-up routine should be applied in order to have an early diagnosis of the sequelae that could lead to the loss of the primary tooth. However, Crespi (16) believes that the child's age and the teeth development stage has a significant role when deciding on the treatment and prognosis.

Following the same line of thought and confirming the findings, the associations between the presence or absence of risk factors, among the types of trauma (mild and severe) and the child's age (above or below three) to identify if in any of these cases the development of severe sequel is more common. None of the associations was statistically significant, leading to the conclusion that all types of trauma, regardless of the age they happen, should receive long-term follow-up treatment (Table 7).

Irrespective of differences in time, age, child's behavior and a physiologic root resorption, every traumatized tooth must be under periodic control both clinically and radiographically, as problems may arise in the short, medium or long-term. The care given to a primary tooth must be similar to the care given to a permanent tooth.

# Conclusion

- **1** Among the sequelae diagnosed in the primary traumatized teeth, mobility, crown discoloration and root canal obliteration were the most frequent ones.
- 2 Other frequent sequelae such as inflammatory and replacement root resorption were found by the association of clinical and radiographic examination at the UFSC follow-up management routine. When these sequelae are not treated, they may lead to the early loss of the primary tooth.

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