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The role for 'reminders' in dental traumatology: 3. The minimum data set that should be recorded for each type of dento-alveolar trauma – a review of existing evidence

Day PF, Duggal MS. The role for 'reminders' in dental traumatology: 3. The minimum data set that should be recorded for each type of dento-alveolar trauma – a review of existing evidence. © Blackwell Munksgaard, 2006.

Abstract – The aim of this study was to establish the prognostic factors recorded at the time of diagnosis or initial treatment that affect pulp and periodontal healing and tooth survival. A search strategy and quality assessment method was established to review the literature. The significant factors identified are listed for each type of dento-alveolar injury. These factors identified are the gold standard against which quality assessments of dento-alveolar trauma records can be compared and all new computer or paper-based methods for recording any type of dento-alveolar trauma should aim to record this minimum information.

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Most guidelines for the management of trauma do not give a minimum data set that should be recorded at the first visit for different types of dento-alveolar injuries. For many of the periodontal injuries, however, the prognosis is usually determined at the time of the injury and in one study none of the treatment variables were found to influence the prognosis of the pulp survival (1). In our efforts to develop a computer database for the purposes of recording important prognostic information at the initial trauma consultation, it was clear that a thorough literature search was required for this purpose. The review presented in this article examined the prognostic factors that need to be recorded for different types of dento-alveolar trauma. This was then used as a gold standard to compare the quality of clinical records using different methods of recording for a later study (2). We carried out a literature search to identify these factors by using the following Medline search strategy (Table 1). In addition, where published papers were identified, the references were examined for other relevant papers.

The inclusion criteria were:

- A clinical study with a minimum of 20 cases
- Prognostic factors must have been recorded at the time of injury
- Humans trials only
- Permanent teeth only.

The results of the literature review for which factors could be considered as important for recording will be discussed injury by injury.

Accident and the patient

Five factors were deemed important to record at the time of any dento-alveolar injury:

Table 1. Medline search strategy for prognostic factors for dento-alveolar trauma

No.	Search history	Results	Display
1	Prognosis/	66 380	Display
2	Human/	2 408 368	Display
3	Reminder systems/or computers/	2516	Display
4	Dentition, permanent/	286	Display
5	Adolescent/or tooth fractures/or incisor/or tooth injuries/or maxillofacial injuries/or tooth avulsion/	258 976	Display
6	Dental concussion.mp.	0	–
7	Subluxation.mp.	1223	Display
8	Concussion.mp.	373	Display
9	'Tooth root'/or dislocations/or tooth fractures/or tooth avulsion/or tooth injuries/or alveolar process/	6804	Display
10	'Tooth root'/or tooth movement/or extrusion.mp.	4949	Display
11	Incisor/or tooth movement/or intrusion.mp.	4602	Display
12	crown facture.mp.	0	–
13	Adolescent/or tooth crown/or incisor/or tooth fractures/or dental pulp necrosis/or uncomplicated crown fracture.mp.	258 909	Display
14	uncomplicated crown fracture.mp.	3	Display
15	Tooth injuries/or tooth crown/or complicated crown fracture.mp. or calcium hydroxide/or dental pulp capping/or pulpotomy/	1730	Display
16	complicated crown fracture.mp.	7	Display
17	'Tooth root'/or tooth, nonvital/or crown root fracture.mp. or incisor/	4692	Display
18	Crown root fracture.mp.	10	Display
19	Tooth root fracture.mp.	2	Display
20	Lateral luxation.mp.	12	Display
21	Intrusion.mp.	673	Display
22	Extrusion.mp.	2453	Display
23	Risk factors/	126 220	Display
24	1 and 2 and 4 and 5	8	Display
25	1 and 2 and 4	14	Display
26	2 and 4	282	Display
27	2 and 4 and 7	3	Display
28	2 and 4 and 8	5	Display
29	2 and 4 and 9	43	Display
30	2 and 4 and 10	17	Display
31	2 and 4 and 11	52	Display
32	5 or 7 or 8 or 9 or 10 or 11 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22	268 187	Display
33	2 and 4 and 32	165	Display
34	1 and 2 and 23 and 32	1449	Display
35	4 and 34	2	Display

- A full history of the accident should as a minimum have included what happened, where and when. By recording when the accident occurred, and the time of treatment, the effect of the time delay between the two events can then be examined. Andreasen et al. (3) have shown that delay in the provision of treatment has a variable effect depending on the injury.
- A current medical history should be completed on the date of presentation.
- Did the patient lose consciousness? This should be recorded with a positive or negative answer even if no loss of consciousness occurred.
- A record of a thorough examination of extra and intra oral findings, including examination of hard and soft tissues and the rest of the dentition.
- If the trauma has resulted in a fracture of a tooth, what happened to the fragment? The fragment can be deposited in the lungs, gastrointestinal tract, oral cavity, other parts of the body (e.g. knee) or spat out.

These factors are in agreement with the dento-alveolar trauma textbooks (4–8), papers on the subject (9) and guidelines on clinical examination and record keeping (10).

Prognostic factors that effect pulpal, periodontal or tooth survival for different types of dento-alveolar injury

Enamel fractures and infractions

The prognostic factors that have been shown to have a significant effect on pulpal survival include:

- *Concurrent periodontal injury*. It has been shown that where there is no periodontal injury, enamel infractions and fractures have no effect on pulpal survival (11, 12).

Enamel dentine fractures

The prognostic factors that have been shown to have a significant effect include:

- *Concurrent periodontal injury*. It has been shown that the extent of the periodontal injury was significantly related to the chances of pulp necrosis. Where there was no periodontal injury, the rate of pulpal necrosis was 3% and with a concussion injury to the periodontal injury, pulpal necrosis increased to 6%. Where the periodontal injury was a subluxation, pulpal necrosis was 30% (13). Similar results were also published in another study (14).
- *Apical maturity* had no effect on pulp survival unless there was a concomitant periodontal injury. In one published study (14) of the 28% of teeth with enamel dentine fractures and concomitant periodontal injuries that lead to pulp necrosis, 81% had closed apices.
- *Length of time the fracture was left before presenting for treatment*. It has been shown (13) that where no pulpal protection was provided pulp necrosis increased from 7.8% to 54.2%. In addition, another published study gave a more detailed time frame showing that where treatment was provided at >3 days there was a threefold increase in pulp necrosis, from 7% to 24% (15). This study did not, however, describe if any concomitant periodontal injuries were present.
- *Type of enamel dentine fracture*. Poorer prognosis for pulpal survival has been reported with certain types of fracture which involved the gingival margin (13). This is probably related to the material used in the late seventies as, without dentine bonding agents, it was difficult to isolate and restore deep gingival dentine fractures with a bacterially tight seal. Nobody has repeated this analysis with modern materials to see if this is still a significant factor.
- *Positive response to pulpal sensibility tests at the time of injury*. In one study (13), 97% of enamel dentine fractures gave a positive response to sensibility testing at initial time of presentation with the injury; only 4% subsequently became non-vital. Of those teeth that did not respond to vitality tests at initial presentation 28% subsequently were found to be vital. There are problems with pulpal sensitivity with both operator and patient variation. Andreasen and Andreasen (4) stated that 'pulpal sensitivity testing requires the co-operation and a relaxed patient in order to avoid false reactions'. Often when young children present with dento-alveolar trauma they are traumatized and have a limited co-operation. In addition, the teeth are often covered in blood and difficult to examine fully without local anaesthesia which negates the use of pulpal sensibility testing.

Enamel dentine pulp fractures

The prognostic factors that have been shown to have a significant effect include:

- *Concurrent periodontal injury*. An associated periodontal injury increased pulp necrosis from 0% to 14% (14).
- *Apical maturity*. Robertson et al. (14) found pulpal healing was not affected by apical maturity. The treatment provided was a mixture of pulp capping and pulpotomy, but no more details were given. Excellent success rate (96%) of pulpotomies, irrespective of apical maturity, has been reported (16). Apical maturity reduced pulpal survival for pulp capping procedures but this did not reach a significant level (17). Another retrospective study (18) was unable to clarify whether apical maturity itself influences the success rates because pulp capping was performed in only those teeth that had a closed apex, and a pulpotomy had been performed wherever the traumatized teeth were considered to have incomplete root development.

Crown root fractures (enamel dentine cementum and enamel dentine pulp cementum fractures)

- *Concomitant periodontal injuries*. Although there is some research into the treatment options for these types of fracture, there is no study that the authors could find relating to concomitant periodontal injuries as a prognostic factor. It would appear logical, however, working from research already published on enamel dentine fractures and enamel dentine pulp fractures, that a concomitant periodontal injury would reduce the chances of pulpal survival.
- *Apical maturity*. As stated with concomitant periodontal injuries, there were no studies that we could identify relating to apical maturity as a prognostic factor. However, it would be safe to assume that apical maturity will certainly influence the treatment undertaken and with a greater chance of pulpal survival for teeth with incomplete root development due to their robust blood supply.
- *Extent of fracture*. This is important to determine at the first treatment visit and whether the fracture extends sub or supra alveolar. The treatment options available are influenced by the extent of the subgingival fracture, the involvement of the pulp, the morphology of the lesion (whether the

incisal edge is implicated or not), the length and/or morphology of the root and the aesthetic result required (19).

Root fractures (dentine pulp cementum fractures)

- *Concomitant crown fracture.* In one study a concomitant crown fracture had a significant effect on pulp survival in root fractured teeth (20), but this was not substantiated in another study (21).
- *Concomitant periodontal injury.* Various studies (20–22) have shown that a concomitant periodontal injury to the coronal fragment significantly affects the type of fracture healing seen in root fractures. Concomitant periodontal injury was also found to have a significant negative correlation with pulp survival of the coronal fragment (21).
- *Degree of displacement of coronal fragment (in mm).* This is a clinical measure to give more detail of the extent of the periodontal injury suffered by the coronal fragment. The extent of the displacement may influence whether treatment is provided. The degree of displacement of coronal fragment was investigated (21) and shown to significantly affect pulp survival and type of root fracture healing.
- *Interference with the occlusion.* This is examined by the clinician and also assessed by the subjective problems complained of by the patient. Where there is interference this will influence what treatment is provided, though no specific studies have reported on this aspect.
- *Apical maturity.* Immature teeth were significantly more likely to retain their pulpal vitality (21, 23). The stage of root development also affected the type of fracture healing seen in root fractures (21, 22).
- *Location of fracture.* The site of fracture affected significantly the survival of the coronal fragment (20).
- *Displacement of coronal fragment on radiograph at the fracture site.* The distance between root fragments at the root fracture site was significantly related to the type of healing (21, 22) and pulp necrosis (21).
- *Positive response to pulpal sensibility tests at the time of injury.* A positive response to pulpal sensibility tests was significantly related to the type of fracture healing that occurred (22). Also, a significant relationship between positive response to pulpal sensibility testing and pulp survival has been reported (21).

Alveolar fracture

- *The time interval between injury to permanent fixation.* The time between injury to permanent fixation was reported to be significantly related to the chances of pulp survival (24).

Concussion

- *Concomitant crown fracture.* Infractions had no significant effect on pulp survival (1). Comparing graphs from two books of Andreasen and Andreasen (5) and Andreasen et al. (6), there appear to be little difference in pulp survival following concussion injuries with or without crown fractures.
- *Tenderness to percussion in the vertical and/or horizontal directions in the absence of tooth mobility* is a prognostic factor for the diagnosis of concussion (4). This allows another clinician to come to the same diagnosis where only the clinical notes are available.
- *Apical maturity.* A significant reduction in pulp survival related to apical maturity has been reported (1, 6).
- *Positive response to pulpal sensitivity tests at the time of injury.* A significant relationship between a positive response to pulpal sensibility tests at the time of the injury and pulpal survival has been reported (25).

Subluxation

- *Concomitant crown fracture.* A reduction in pulpal survival has been reported where there was a concomitant crown fracture (5) compared with figures for subluxation injuries without concomitant crown fractures (6). This effect was more pronounced in teeth with a closed apex. However, as the precise figures and numbers of study population were not reported, it was not possible to ascertain if this was significant.
- *Mobility of the tooth with no displacement from the original position.* This is the diagnostic factor for subluxation (4). This allows another clinician to come to the same diagnosis where only the clinical notes are available.
- *Tenderness to percussion and pain on occlusion* were significantly related to pulpal necrosis (1).
- *Apical maturity.* A significant reduction in pulp survival in relation to the stage of root formation has been reported (1).
- *Positive response to pulpal sensitivity tests at the time of injury.* A significant relationship between a positive response to pulpal sensibility tests at the time of the injury and pulpal survival has been reported (1).

Extrusion

- *Concomitant crown fracture.* A reduction in pulpal survival has been reported where there was a concomitant enamel dentine fracture (5) compared with figures for extrusion injuries without

concomitant crown fractures (6). This effect was more pronounced in teeth with a closed apex. As both these graphs do not give precise figures and numbers of study population, it is not possible to ascertain if this is significant. Concomitant infraction of the enamel for extrusive injuries was not significant for pulpal survival (1).

- *Degree of displacement (in mm).* This is a clinical measure to give more detail of the extent of the periodontal injury suffered. The extent of the displacement may influence whether treatment is provided. The degree of displacement was not significantly related to pulpal survival for extrusive injuries (1, 26). This is in contrast to another study which reported that the severity of the injury (e.g. extrusion of the tooth >3 mm) significantly related to pulpal survival (27).
- *Interference with the occlusion.* This is examined by the clinician and also assessed by the subjective problems complained of by the patient. Where there is interference, this will influence what treatment is provided. Pain on occlusion was significantly related to pulp survival for extrusive injuries in one study (1).
- *Apical maturity.* A highly significant relationship between pulpal survival and the apical maturity for extrusive injuries has been reported (1, 27). This was still highly significant with multivariate survival analysis.
- *Pulp canal obliteration.* Pulp canal obliteration was a common method of healing for the pulp and was significantly related to the severity of the injury (27).
- *Time delay in seeking treatment.* Residual incisor extrusion post repositioning was found to be significantly related to a delay, >3 h, in repositioning (27).

Lateral luxation

- *Concomitant crown fracture.* A reduction in pulpal survival has been reported where there was a concomitant crown fracture (5) compared with figures for lateral luxation injuries without concomitant crown fractures (6). This effect was more pronounced in teeth with an open apex. As the graphs presented did not give precise figures and numbers of study population, it is not possible to ascertain if this was a significant association. For lateral luxation injuries concomitant infractions of the enamel were also significant for pulpal survival (1).
- *Degree of displacement (in mm).* This is a clinical measure to give more details of the extent of the periodontal injury suffered by the tooth. The severity of the displacement may influence the diagnosis or whether treatment is provided. The degree of displacement was not significant for pulpal survival for lateral luxation injuries (1, 28). Though figures have been published for periodontal healing after luxation injuries, these were not correlated with the degree of displacement probably due to the small number of teeth affected (1).
- *Interference with the occlusion.* This is examined by the clinician and also assessed by the subjective problems complained of by the patient. Where there is interference, this will influence what treatment is provided.
- *Mobility.* The degree of mobility for a lateral luxated tooth has been shown to be significantly related to pulpal survival (1).
- *Apical maturity.* A highly significant relationship between pulpal survival and apical maturity for lateral luxation injuries was found in one study (1); no relationship was found in another study (28).
- *Positive response to pulpal sensitivity tests at the time of injury.* A significant relationship between a positive response to pulpal sensibility tests at the time of the injury and pulpal survival has been reported (1).
- *Number of injured teeth in the same dental arch.* This was a significant factor for the development of pulpal necrosis (1).
- *Pulp canal obliteration.* Pulp canal obliteration was common with 40% of the sample healing in this way. However, this type of healing was not correlated with any other prognostic factors studied (28).

Intrusion

- *Concomitant crown fracture.* A significant relationship between concomitant crown fracture and pulpal survival has been reported (29, 30).
- *Degree of displacement (in mm).* This is a clinical measure to give more detail of the extent of the periodontal injury suffered. A number of authors (1, 29–31) have found that the degree of displacement is significantly related to pulpal necrosis, periodontal healing and tooth survival.
- *Apical maturity.* Apical maturity has been reported to affect both pulpal and periodontal healing (1, 29).
- *Treatment.* There is some dichotomy of thought between authors on the preferred method of treatment for this injury. Treatment options include passive repositioning, immediate active repositioning with super orthodontic forces, delayed (2–3 weeks) active repositioning with super orthodontic forces and immediate surgical repositioning (30). No studies have randomly compared different treatment methods. None of the current published literature has shown a

significant superior effect of a particular method of treatment comparing similarly injured teeth (1, 29–32).

Avulsions

The details of prognostic factors have been fully discussed in a previous paper (33). Therefore, a list of these factors only is presented here.

- Further injuries to the avulsed tooth itself (other dento-alveolar injuries)
- Apical maturity of root and age of the patient
- Storage mediums and the amount of time spent in each prior to replantation
- The time the tooth is kept dry prior to replantation
- The total time the tooth is out of the mouth prior to replantation
- The contamination of the periodontal ligament and any cleaning of the root face prior to replantation
- Where antibiotics are given topically or systemically at the time of replantation.

Summary

Before multicentre prospective studies are undertaken for dento-alveolar trauma important information that should be recorded for each injury needs to be identified. Such standardized format would allow larger prospective studies to be carried out with adequate number of patients for statistical power and would allow comparison between centres. This consensus on what to record for each injury also ensures comparison between studies and consistency in what data to collect when clinicians and or researchers develop new methods of data collection such as computer databases. In this paper we have attempted to identify the minimum information that should be recorded for each type of dento-alveolar injury.

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