

TRAUMATIC INJURIES TO THE TEETH OF CHILDREN

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GENERAL

It is obvious that as mechanisation increases on the roads, in the homes and everywhere in everyday life, there will probably be at least a slight increase in number of accidents and traumata. The dental injuries will not make an exception to the trend. The dental profession should be well prepared to combat these injuries by means of prevention and therapy. For a proper diagnosis and treatment certain skills are required for the practitioner to be successful. The intention of this paper is to attach some importance to the knowledge and skills required in dentistry for children, and in particular as it relates to the dental injuries.

This paper will be limited to the hard tissues and their traumata, and only a few aspects of soft tissue traumata will be touched upon.

CLASSIFICATION OF TRAUMATIC DENTAL INJURIES

In recent years a system developed by J. O. Andreasen has been introduced into general use. The classification is based on grouping the injuries into two types of traumata i.e. those involving hard dental tissues and those affecting periodontal tissues. Besides, lesions of the bone and on the other hand, traumata of the gingivae and oral mucosa form their own respective groups. The classification serves to make a diagnosis as well as to guide the treatment required.

It should be observed that a tooth may show more than one diagnosis at the same time. The combination of crown fracture and subluxation is, for instance, a common occurrence.

Table 1 shows the classification according to the system presented by J. O. Andreasen.

Table 1 — Traumatic dental injuries

A. Injuries of hard dental tissues

Class 1	Infraction of enamel	Partial fracture of enamel with no loss of hard tissue.
Class 2	Uncomplicated crown fracture Type A.	Fracture confined to enamel with loss of tissue.
	Type B.	Fracture confined to enamel and dentine with loss of tissue but the pulp not involved.
Class 3	Complicated crown fracture	Fracture of enamel and dentine with loss of tissue and involvement of the pulp (exposure).
Class 4	Crown-root fracture uncomplicated	Involving enamel, dentine and cementum but not the pulp.
Class 5	Crown-root fracture Complicated	Involving enamel, dentine and cementum as well as the pulp.
Class 6	Root fracture	Involving cementum, dentine and the pulp (not the enamel).

B. Periodontal injuries

Class 7	Concussion	Injury to the periodontium without displacement or loosening.
Class 8	Subluxation	Loosening but no displacement.
Class 9	Intrusion	Axial displacement into the alveolar bone.
Class 10	Extrusion	Partial displacement out of the socket.
Class 11	Lateral luxation	Displacement otherwise than axial after an alveolar bone fracture etc.
Class 12	Avulsion	Exarticulation or complete detachment of the tooth.

EPIDEMIOLOGY OF DENTAL INJURIES

While there is no exact data available about the occurrence of dental injuries to children in Tanzania, it may be assumed on the basis of several recent reports from elsewhere in the world, in particular Scandinavia, that the traumatic dental injuries to children's teeth are relatively common.

According to some recent studies it can be concluded that approximately 30 per cent of the children sustain injuries to the primary teeth. The respective figure for the permanent teeth is about 20 per cent.

The practical significance of the problem of dental injuries can be seen from the fact that one third of all boys and one fourth of all girls can be expected to sustain a trauma before leaving school at the age of sixteen years.

The incidence of the injuries to the deciduous teeth has its peak at the age of 3 years, whereas in the permanent dentition the most common age of trauma is between 8 and 11, with a peak at about 9.

Boys suffer about twice as many injuries to permanent teeth as girls. Even in the preschool age boys are reported to outnumber girls.

Table 2. Shows the difference between boys and girls, as well as the prevalence of injuries to anterior teeth in a Finnish population.

Table 2.
Prevalence (%) by age of traumatically injured anterior teeth of children in a Finnish population (Jarvinen & Lehtinen, 1983).

Age (years)	Deciduous dentition			Permanent dentition		
	3	6	9	12	14	16
Girls	15.0	—	10.0	19.3	33.8	15.5
Boys	18.1	2.3	18.8	33.0	36.1	21.3
Girls & Boys	16.6	1.1	14.5	26.7	35.1	18.1

Dental injuries usually affect one or two teeth, and the maxillary central incisors are most frequently involved in both dentitions.

Table 3. Shows the distribution of injuries between various teeth in the permanent and deciduous dentition.

Table 3.
The frequency of injuries in various teeth (%) (Jarvinen & Lehtinen, 1983).

Teeth	Upper central incisors	Upper lateral incisors	Lower central incisors	Lower lateral incisors
Deciduous dentition				
boys and girls	83.5	14.1	—	2.4
Permanent dentition				
boys and girls	81.7	6.8	6.3	5.2

In the permanent dentition uncomplicated crown fracture is the most common type of injury as is indicated in Table 4, underneath.

Table 4.

Distribution of traumatic injuries among children, 7 — 16 years of age (Jarvinen, 1977) in a Finnish epidemiological material (%) and permanent dentition.

Type of injury	Percentage
Infraction of enamel	5.8
Uncomplicated crown fracture	90.5
Complicated crown fracture	1.8
Root fracture	0.2
Avulsion	1.7

In contrast to the permanent dentition, periodontal injuries such as Subluxation and luxation dominate in the primary dentition. This is probably due to the resilience of the alveolar bone in the primary dentition, favouring a loosening, a displacement or even an exarticulation rather than fractures of the hard dental tissues.

AETIOLOGY OF DENTAL INJURIES

The traumatic lesions of the teeth may be brought into being in two ways: Either there is a direct trauma caused by the injurious factor e.g. a blow on a tooth with some object. In this manner most of the injuries of anterior teeth are brought about.

In an indirect trauma the shock at the dentition is transmitted through the lower jaw. Especially injuries occurring in the molar and premolar areas can often be categorised as indirect traumata.

The extent and type of the injury is influenced by the following factors:—

1. **Mass and velocity of hitting object:** a small object at a high speed leads to a crown fracture, while a big object at a slow speed favours periodontal injuries;
2. **Resilience:** a soft or resilient object usually causes a periodontal injury, whereas a hard one leads to a crown fracture;

3. **Shape:** a sharp object tends to cause a crown fracture, while a blunt one usually causes a periodontal or root fracture;
4. **Direction:** intrusion, extrusion or avulsion presupposes an axially directed blow, whereas a shock perpendicular to the axis produces a lateral luxation or a hard tissue lesion of the tooth.

On the whole a wide variety of factors are responsible for dental traumata. Frequently, though, there is a history of a fall during play, a fall against an object, or a fall from a bicycle.

The main aetiological factor seems to be the motor inco-ordination of the child. Three fourths ($\frac{3}{4}$) of traumata are sustained outdoors, and only one fourth ($\frac{1}{4}$) indoors. There is an almost even distribution in the home, at school and in traffic.

In the deciduous dentition the most common reason for any injury is naturally the falling of the child.

A study of the aetiologies indicates that there are few possibilities of introducing general prophylactic measures. It is evident, however, that children with maxillary protrusion are more susceptible to injuries than children with normal occlusion. Some traumas may therefore be prevented by early orthodontic correction of markedly protruding maxillary incisors. Table 5, shows the relationship between the prevalence of injuries and the degree of horizontal overjet.

Table 5.

Prevalence of injuries in various classifications of the horizontal overjet (Jarvinen, 1978) (%).

	0	0-3mm	3.1-6mm	6mm
less than	0	0-3mm	3.1-6mm	6mm
Girls ...	0	9.9	26.6	30.6
Boys ...	0	18.8	30.0	46.2

The use of mouthguards should be strongly recommended for participants in various types of body-contact sports, because the relatively few dental injuries tend to be severe and to involve a greater number of teeth than other injuries.

DIAGNOSIS of DENTAL INJURIES

The diagnosis is based on the data which is obtained from the case history, the clinical examination and the radiographic examination.

The right therapy is always based on the correct diagnosis. Therefore the information and correct diagnosis. Therefore the information needed for making the diagnosis should be collected methodically and as extensively as possible.

1. History

The patient is questioned about the following:

- **time elapsed** since injury (hours/days). The type of treatment and the prognosis is influenced by the interval;
- **where** the injury occurred? The place of accident indicates if preventive measures against tetanus are required;
- **how** the injury occurred? The direction of the blow may indicate a possible fracture of a condyle, or indicate a damage to the permanent successors in the deciduous dentition;
- **general health.** Did the trauma cause unconsciousness, amnesia; headache, vomiting, excitation or focussing difficulties? This may indicate that referral to medical care will be necessary.
- **symptoms.** Pain during mastication is indicative of damage to the parodontium. **Disturbed occlusion** indicates either tooth displacement or jaw fracture.
- **previous injury** to the teeth in question:— Repeated injuries are not common, but in these patients, prognosis may be less favourable.

2. Clinical examination

The clinical examination includes a general examination (particularly in associated severe injuries), an extraoral examination, as well as an intraoral examination.

In the general examination symptoms of brain concussion and jaw fractures are looked for, whereas the extraoral examination should attach attention to lacerations of the face and lips. A swollen lip is a suspect and should be carefully examined.

The intraoral examination must be systematic and include the recording of:—

- laceration, hemorrhage and the swelling of the oral mucosa and gingiva;
- abnormalities in occlusion;
- displacement of teeth;
- fractured crowns or cracks in its enamel.

Particular note should be taken of the following factors:—

- mobility in both horizontal and vertical directions;
- reaction to percussion, tenderness or pain are indicative of the involvement of the periodontal tissues;
- colour of the tooth. Discoloration may appear immediately after the injury i.e. a pinkish colour indicates pulpal bleeding, and necrotic changes are usually gray;
- reaction to sensitivity test, either by thermal or ethyl chloride, or by the electric test. It should be noted that a control (uninjured) tooth is tested first. Neither a negative nor a positive sensitivity response should be trusted immediately after the trauma. An immediate negative response is frequently due to a damage to the apical nerve supply, healing to be normal after a couple of months.

3. Radiographic examination provides information about

- extent of root development;
- size of pulp cavity;
- thickness of dentin between the pulp and fractured surface;
- presence of root or alveolar fracture;
- displacement in an intrusive/extrusive direction;

— the relationship between the permanent successor and the apex of the intruded primary tooth.

The traumatised area and opposing teeth should be exposed.

TREATMENT OF TRAUMATIC INJURIES

The principles of treatment of permanent teeth differ in their objectives from those of deciduous teeth. In the primary dentition the therapy is of symptomatic nature and in the first place, is in the treatment of permanent teeth is naturally the preservation of the teeth.

Most traumatised permanent teeth can be treated with success. However, quickly implemented emergency treatment decreases the risk of complications.

The initial treatment phase is followed by a period of observation. The intervals between re-examinations depend on the severity of the trauma. However, the following is suggested to serve as a guideline:—

Examination after one week, 3 weeks, and after that in 3, 6 and 12 months' time. Thereafter once a year with the minimum observation period ranging from 4 to 5 years. Even an injury with no obvious clinical or radiographic signs should be observed over a period of not less than one year. The clinical checks include the testing of sensitivity, percussion and mobility, and the inspection of tooth colour. Radiographs are examined with respect to the per-apical condition and changes within the pulp cavity.

I. Infractions of enamel

Infractions in permanent or primary teeth are not indications for actual treatment. However, the energy of the blow may in these incomplete fracture cases, have been transmitted to the periodontal tissues or the pulp, resulting in a pulpal necrosis. Even if no active treatment is required, periodic recalls including sensitivity testing are recommended as necessary. In case of increased sensitivity to cold, heat or sweet, the tooth is

painted with a 2% sodium fluoride solution.

II. Uncomplicated crown fracture

(a) Enamel fracture — type:

When minimal tooth substance is lost, no restoration is needed. Most often a slight contouring and smoothing of sharp edges will provide an aesthetic result.

The contralateral anterior tooth is rounded off similarly to make the teeth symmetrical. In rare instances orthodontic traction or a composite filling will be indicated for a satisfactory appearance.

(b) Enamel-and-dentine fracture — type:

The primary objective with a number of dentinal tubules being exposed, is to protect the pulp from external irritation as well as to promote the formation of a protective dentinal bridge over the affected site of the pulp.

The protective measures are particularly emphasised in young pulps of the children, where the pulpal death is a possible outcome.

The following procedure is recommended:—

The fractured area is cleansed with cotton pellets soaked in physiological saline solution, and after that a layer of calcium hydroxide (CaOH₂) is placed over the exposed surface.

It is nowadays common to repair a fractured anterior tooth with a composite filling material in conjunction with the acid etch technique.

However, there are several situations where the more traditional method of a temporary restoration such as a steel crown, is to be preferred for a period of time. One example is bleeding from soft tissue lacerations making moisture control impossible. In like manner, when the fracture extends subgingivally, when an associated periodontal injury requires the construction of a splint, or when there is a negative sensitivity response, it usually is preferable to use a temporary restoration like a steel crown. The crown is properly trimmed and cemented in place with zinc

oxide eugenol cement. After an observation period of about 4 weeks a corrective grinding, or an acid-etch restoration is made. Other types of semi-permanent fillings are also possible alternatives.

The prognosis is favourable with respect to retained vitality. However, prognosis appears to be markedly worsened if dentine-covering procedures are done later than 24 hours after the accident.

The treatment for primary teeth is the same in principle, but mostly the treatment is limited to the grinding of the sharp edges and fluoride paintings.

III. Complicated crown fracture

The primary objective in the permanent dentition is to preserve the vitality of the exposed pulp, to prevent the pulp from being infected, as well as to enhance the formation of a protective dentinal bridge.

This is not always possible, so the pulp has to be removed. As stated the primary concern with respect to immature teeth is to allow continuance of the process of development both at the apex and within the pulp cavity.

From the information currently available, a vital exposure should, as a rule, be treated by superficial pulpal surgery i.e. pulp capping with calcium hydroxide.

This procedure is often recommended when the lesion is minute and the exposure to saliva is limited to a few hours, as well as when there is no luxation or excessive mobility present.

Until recently the cervical amputation (pulpotomy) has been the treatment of choice in those cases not suited for pulp capping. The objective of amputation is to excise the part of pulpal tissue which is damaged or infected beyond repair.

Pulpotomy involves removal of the coronal pulp. The physiologic dentine production in the crown and the cervical area is thus discontinued and the strength of the tooth may be impaired. In many instances it is recommended to perform a partial amputation of the pulp i.e. partial pulpotomy.

Proportionate to the area of exposed pulp only part of the pulp and surrounding dentine is removed.

After the pulpotomy a temporary restoration is placed, and in about half a year's time, once the protective dentine bridge has been laid, a semi-permanent or permanent restoration is made. In molars the final fillings are placed even earlier.

Pulpectomy and apexification procedures are necessary in cases where the pulp is totally infected or necrotic. The aim of treatment is to induce the normal apical closure of an immature open apical foramen. The medicament used is a paste of calcium hydroxide, which is sealed in well prepared canal for at least half a year. Observation is done by X-rays and once the apical closure is complete, the normal root canal filling is inserted. Usually a reinforced restoration is needed for a root-treated tooth i.e. a dowel post or a screw post etc.

For the primary dentition, normally extraction is the treatment of choice. With the child being co-operative the same procedures as for permanent teeth, may be followed with the exception that putrescent/necrotic or totally infected primary teeth are indicated for extraction.

IV. Crown-root fracture

The same principles are applied as in crown fractures, if the tooth is to be retained.

A loose coronal fragment is removed and the exposed dentine is protected. In complicated cases a pulp capping or a pulpectomy is chosen for treatment.

The tooth is extracted in cases where the coronal fragment involves more than one third of the clinical root and when the fracture line runs parallel to the axis of the tooth. Orthodontic extrusion or surgical expose of the fracture surface are rare means of treatment.

In the deciduous dentition the restorative treatment is extremely difficult and hence the tooth is almost invariably extracted.

V. Root fractures

The method of treatment is determined by the position of the fracture line.

If the line of fracture runs in the coronal third of the root, the following methods are available:—

- (a) extraction of the tooth
- (b) surgical exposure of the fracture surface
- (c) orthodontic extrusion of the root

If the fracture line is situated in the apical or middle third of the root, the method of treatment will be:—

- (a) reposition of the coronal part, followed by
- (b) stabilisation.

The most common complication of a root fracture is the pulp necrosis. It may occur either in both or only in the coronal fragments.

If the apical fragment is preserved vital, and there is no periapical process visible, the root canal treatment of the coronal fragment is performed. The obturation may be done immediately or alternatively a temporary calcium-hydroxide filling may be inserted, until the apical end of the fragment is classed by the formation of dental hard tissue.

Both the fragments will be treated if the pulps in both the fragments are necrotic. The gut-tapercha filling should not be inserted between the fracture surfaces of the fragments.

If there is a wide dislocation in the fracture line, the coronal fragment is recommended for root canal therapy whereas the apical part is surgically extracted.

Metalic implants are sometimes used to support the remaining coronal fragment. The implant is inserted through the root canal and extends 2—4mm below the original apex.

The principles of treatment for the primary dentition differ considerably from those applied in the permanent dentition:—

1. If the displacement of the coronal fragment is small, a spontaneous healing will be allowed to occur after the reposition of the fragment, no splinting is done.
2. If the dislocation is remarkable, the coronal fragment is removed, but the apical fragment is retained because normal resorption is to

be expected, and the follicle of the permanent tooth will be damaged.

PERIODONTAL INJURIES

For the treatment of concussions and subluxations it usually suffices to reduce masticatory pressure in occlusion e.g. by grinding the antagonist tooth slightly. In cases of extrusion a tooth is repositioned and immobilised by splinting. In intrusion the best reposition method is orthodontic with the exception of immature teeth which erupt spontaneously back in occlusion. Lateral luxation requires at least a splinting period of 6—8 weeks after reposition.

The treatment of deciduous teeth is much simpler than that of permanent teeth. For concussions and subluxations only a period of observation is enough, extraction is usually applied to extruded primary teeth, and spontaneous healing is expected to take place in cases of intrusion and lateral luxation. If radiographically a damaged permanent follicle is detected, the guilty deciduous tooth is extracted.

The conventional method of treatment of avulsion or exarticulation is the replantation and immobilisation of the avulsed tooth. Not until two to three weeks have elapsed after the replantation, should the necessary endodontic therapy be started. The form of endodontic therapy depends on the state of the pulp and the stage of apexogenesis.

No replantation is recommended for exarticulated milk teeth.

SUMMARY

In order to maintain the harmony and function of the masticatory apparatus, as well as to guarantee its normal growth and development, it is highly recommended that sufficient attention be attached to various possibilities of treatment of dental injuries. Extraction must not be the only way of emergency treatment in cases where more beneficial therapies are available. Prevention should however be the main strategy in dealing with traumata affecting the teeth.

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