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Management of Traumatic Injuries to the Teeth and Supporting Tissues of Children

Injuries to the teeth of children or adults present unique problems in diagnosis and treatment. The diagnosis of the extent of the injury after a blow to a tooth, regardless of loss of tooth structure, is difficult and often inconclusive. Trauma to a tooth is invariably followed by **pulpal hyperemia**, the extent of which cannot always be determined by available diagnostic methods. **Congestion and alteration in the blood flow** in the pulp may be sufficient to initiate i**rreversible degenerative changes** which, over time, can cause **pulpal necrosis**. In addition, the apical vessels may have been severed or damaged enough to interfere with the normal reparative process. Treatment of injuries causing pulp exposure or tooth displacement is particularly challenging because the prognosis of the involved tooth is often uncertain.

The treatment of fractured teeth, particularly in young patients, is further complicated by the often difficult but extremely important restorative procedure. Although the dentist may prefer to delay the restoration because of a questionable prognosis for the pulp, often a malocclusion can develop within a matter of days as a result of a break in the normal proximal contact with adjacent teeth. Adjacent teeth may tip into the area created by the loss of tooth structure. This loss of space will create a problem when the final restoration is contemplated. There must often be a compromise of an ideal aesthetic appearance, at least in the initial restoration, because the prognosis is questionable or because the tooth is young and has a large pulp or is still in the stage of active eruption.

The likelihood of success often depends on the **rapidity** with which the tooth is treated after the injury, regardless of whether the procedure involves protecting a large area of exposed dentin or treating a vital pulp exposure. Trauma has a great psychological impact on both the child and his parents, since these fractures may affect the child's appearance and make him the target for teasing by other children. Trauma to the dentition should always be considered an **urgent condition** which should be treated immediately and efficiently.

Prevalence of dental trauma:

The prevalence of dental injury varies according to different nationalities. It is **more** in primary dentition than it is in the permanent dentition.

Age distribution:

Peak incidence for primary dentition is **2-4 years** (This is the age when a child learns to toddle and is relatively uncoordinated). For permanent dentition and according to many Iraqi studies, the highest occurrence of dental injury was found in the age interval of **9-11** years of age (This could be attributed to the fact that children are usually more active in this period of life and they cannot precisely evaluate velocity and danger).

Gender:

For permanent teeth, **boys** are more susceptible to traumatic injuries than girls in the ratio of 1.5: 1(according to Iraqi study in 2011). In primary dentition **no sex predilection** is seen.

Seasonal variation:

A relationship seems to exist between the time of the year and the prevalence of dental injuries. These seasonal studies have shown that the frequency of the injuries increases during autumn and winter (time of school beginning).

Site:

Majority of the injury occurred to the anterior teeth and in particular to the **maxillary central incisor.**

NoteS

1. 90 % of the traumatic injuries occurs in maxilla.
2. Injuries to anterior teeth can be classified as **direct** (result from a blow on the tooth by some object) or **indirect** (blow to the chin may cause sudden forceful closure of mandibular teeth with their maxillary opponents, as may follow a fall, a fight or road accident).

3. Predisposing factors for traumatic dental injuries include physical features such as increased incisal over jet (class II div.1), open bite protrusion and lip incompetence.
4. The common causes of trauma to teeth are listed below:
   ☹ Falls and collisions
   ☹ Sporting activities
   ☹ Domestic violence (e.g. Child abuse)
   ☹ Road traffic
   ☹ Inappropriate use of teeth.
   ☹ Presence of illness (e.g. learning difficulties or physical limitations: Epilepsy, Cerebral palsy, Learning difficulties, Hearing and visual impairments).
5. In primary teeth, injury usually results in **displacement or avulsion** of teeth rather than fracture (why).

Trauma to the face:

It will cause either tooth fracture or displacement. Tooth fracture may be the cause of concussion or subluxation, displacement which is either partial or total.

1. Tooth Fracture: The first thing occur:

a. Concussion: Sensitivity of the tooth due to trauma without abnormal loosening or mobility. The tooth may be sensitive to percussion usually caused by a mild blow.

b. Subluxation: Loosening of the tooth without displacement, due to a more severe blow resulting in injury to periodontal ligament.

2. Displacement /luxation: a. partial displacement

b. total displacement **(avulsion)**

Partial displacement: caused by direct or indirect trauma.

Injuries caused by direct trauma may cause:

1. Palatal or lingual movement of the tooth with palatal fracture of the alveolar bone.

2. Palatal or lingual movement of the tooth with buccal alveolar bone fracture.

3. Displacement of the tooth from its socket without alveolar bone fracture and the tooth appear longer (**Extrusion)**.

Injuries caused by indirect trauma may cause:

1. Labial movement of the tooth with fracture of palatal or lingual alveolar bone.

2. Labial movement of the tooth with fracture of labial alveolar bone.

3. Displacement of a tooth in an apical direction **(Intrusion).**Tooth is pushed into the socket, the tooth appear shorter and it may cause fracture of the bone at the floor of the socket in most of the cases.

HISTORY OF THE INJURY

A dental injury should always be considered as an emergency and be treated immediately to relieve pain, facilitate reduction of displaced teeth and improve prognosis. Rational therapy depends upon a correct diagnosis, which can be achieved with the help of various examination techniques.

The time of the injury should first be established. Unfortunately, many patients do not seek professional advice and treatment immediately after an injury. Occasionally the accident is so severe that dental treatment cannot be started immediately because other injuries have higher priority. Patients and parents do not give importance to traumatic dental injuries and have tendency of attending after a time elapsed or waiting until they had acute symptoms of inflammation and/or esthetic problems.

If the force strong enough to fracture, intrude, or avulse a tooth, it is also strong enough to result in cervical spine or intracranial injury. The dentist must be particularly alert to such potential problems, be prepared ahead of time to make a neurologic assessment, and make appropriate medical referral when indicated without delay. The patient should be assessed for nausea, vomiting, drowsiness or possible cerebral spinal fluid leakage from the nose and ears, which would indicate a skull fracture, the patient should be evaluated for lacerations and facial bone fractures.

Obtaining a baseline temperature, pulse, blood pressure, and respiratory rate should be considered as information to be gathered before addressing the dental needs of the patient.

A quick cranial nerve evaluation involving the following four areas:

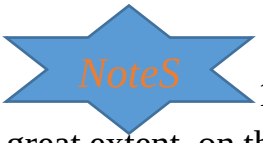
1. Extraocular muscles are intact and functioning appropriately; that is, the patient can track a finger moving vertically and horizontally through the visual field with the eyes remaining in tandem.

2. Pupils are equal, round, and reactive to light with accommodation.

3. Sensory function is normal as measured through light touch to various areas of the face.

4. Symmetry of motor function is present, as assessed by having the patient frown, smile, move the tongue, and perform several voluntary muscular movements.

Taking a complete dental history can help the dentist learn of previous injuries to the teeth in the area. Repeated injuries to the teeth are not uncommon in children with protruding anterior teeth and in those who are active in athletics. In these patients the prognosis may be less favorable. The dentist must rule out the possibility of a degenerative pulp or adverse reaction of the supporting tissues as a result of previous trauma.



1) The prognosis of an injured tooth depends logically, often to a great extent, on the time that has elapsed between the occurrence of the accident and the initiation of emergency treatment. This is particularly true in cases of avulsion and pulp exposure, for which pulp capping or pulpotomy would be the procedure of choice.

2) The prognosis of the injured teeth maintaining pulp vitality diminished when treatment was delayed. The loss of vitality of some injured teeth occurred as early as 3 months and as late as 24 months after the injury, which justifies a long follow-up period after injury.

3) The patient's complaints and experiences after the injury are often valuable in determining the extent of the injury and in estimating the ability of the injured pulp and supporting tissues to overcome the effects of the injury.

A. Pain caused by thermal change is indicative of significant pulpal inflammation.

B. Pain occurring when the teeth are brought into normal occlusion may indicate that the tooth has been displaced. Such pain could likewise indicate an injury to the periodontal and supporting tissues.

C. Spontaneous pain can indicate damage to the tooth supporting structures, e.g., hyperemia or extravasation of blood into the periodontal ligament. Damage to the pulp due to crown or crown-root fractures can also give rise to spontaneous pain.

D. Mobility of the tooth at the time of the first examination increase the likelihood of eventual pulpal necrosis. The greater the mobility, the greater the chance of pulpal death.

4) Trauma to the supporting tissues may cause sufficient inflammation to initiate external root resorption. In instances of severe injury, teeth can be lost as a result of pathologic root resorption and pulpal degeneration.

CLINICAL EXAMINATION

For any fracture case, an accurate medical and dental history should be taken with record information about the condition involves that could be related to the:

1. Cause of the fracture

2. Place of fracture which could be dirty, contaminated, or clean place, the place of accident may indicate a need for tetanus prophylaxis.

3. The Time of fracture for the treatment plane (for ex. To see the vitality of the tooth). If the fracture before one year, there is high probability that the tooth is non-vital.

4. Pain is very important in determining the extent of the injury.

The clinical examination should be conducted after the teeth in the area of injury have been carefully cleaned of debris. When the injury has resulted in a fracture of the crown, the dentist should observe the amount of tooth structure that has been lost and should look for evidence of pulp exposure. With the aid of a good light, the dentist should carefully examine the clinical crown for cracks and craze lines, the presence of which could influence the type of permanent restoration used for the tooth. With light transmitted through the teeth in the area, the color of the injured

tooth should be carefully compared with that of adjacent uninjured teeth. **Severely traumatized teeth often appear darker and reddish**.

Diangelis and colleagues have advocated the following classification of crown fractures in describing the extent of damage to the crown of the tooth:

Crown fracture–uncomplicated: an enamel fracture or an enamel-dentin fracture that does not involve the pulp.

Crown fracture–complicated: an enamel-dentin fracture with pulp exposure.

Methods of Clinical Examination

1. Visual Examination:

a. Any leakage of straw colored fluid from the nose, bruising, hemorrhage or laceration of the soft tissues or swelling.

b. Type of fracture.

c. Discoloration of the tooth.

d. Oral hygiene.

e. Occlusion.

f. Deviation in the path of mandible during mouth opening.

The clinical examination should be conducted after the teeth in the area of injury have been carefully cleaned of debris. A piece of cotton moistened with saline or hydrogen peroxide can be used to clean the teeth and surrounded area .When the injury has resulted in a fracture of the crown, the dentist should observe the amount of tooth structure that has been lost and should look for evidence of pulp exposure. With the aid of a good light, the dentist should carefully examine the clinical crown for cracks and craze lines, the presence of which could influence the type of permanent restoration used for the tooth. With light transmitted through the teeth in the area, the color of the injured tooth should be carefully compared with that of adjacent uninjured teeth.

2. Digital examination:

a. Tenderness of the tooth to gentile percussion.

b. Mobility of the tooth.

c. Vitality test of the injured tooth by thermal or electrical pulp tester.

Immediately after trauma, it **does not** give response to vitality test reexamine the tooth after 6 weeks and if the child does not give response, this is an indicator that the tooth is non vital. The injured tooth should be performed, and the teeth in the immediate area, as well as those in the opposing arch, should be tested. When the electric pulp tester is used, the dentist should first determine the normal reading by testing an uninjured tooth on the opposite side of the mouth and recording the lowest number at which the tooth responds. If the injured tooth requires more current than does a normal tooth, the pulp may be undergoing degenerative change, whereas if it required less current, pulpal inflammation is usually indicated. Pulp testing following traumatic injuries is a controversial issue. These procedures require cooperation and a relaxed patient, in order to avoid false reaction. However, this is often not possible during initial treatment of injured patients, especially children. Furthermore, the electric pulp test is frequently unreliable, even on normal teeth when apices are incompletely formed.

The thermal test is also somewhat helpful in determining the degree of pulpal damage after trauma. Although there are difficulties with the thermal test, it is probably more reliable than the electric pulp test in testing primary incisors in young children. Failure of a tooth to respond to heat indicates pulpal necrosis. The response of a tooth to a lower degree of heat than is necessary to elicit a response in adjacent teeth is an indication of inflammation. Pain occurring when ice is applied to a normal tooth will subside when the ice is removed. A more painful and often lingering reaction to cold indicates a pathologic change within the pulp, the nature of which can be determined when the reaction is correlated with other clinical observations.

Failure of a recently traumatized tooth to respond to the pulp test is not uncommon and may indicate a previous injury with a resulting necrotic pulp. However, the traumatized tooth may be in a state of shock and as a result may fail to respond to the accepted methods of determining pulp vitality. The failure of a pulp

to respond immediately after an accident is not an indication for endodontic therapy. Instead, emergency treatment should be completed, and the tooth should be retested at the next follow-up visit.

In children the electric pulp tester is controversy because it needs cooperation and a relaxed child. When the child come from the 1st time because of anxiety the child will give false response.

3. Radiographical Examination:

The examination of traumatized teeth cannot be considered complete without a radiograph of the injured tooth, the adjacent teeth, and sometimes the teeth in the opposing arch. In search of a fractured tooth fragment, it may be necessary to obtain a radiograph of the soft tissue surrounding the injury site.

Radiographs are taken for:

1) Baseline evaluation.

2) Medicolegal records.

3) Follow up evaluation (comparison with the records in future). Frequent, periodic radiographs reveal evidence of continued pulp vitality or adverse changes that take place within the pulp or the supporting tissues. In young teeth in which the pulp recovers from the initial trauma, the pulp chamber and canal decrease in size coincident with the normal formation of secondary dentin. After a period of time an inconsistency in the true size or contour of the pulp chamber or canal compared with that of adjacent teeth may indicate a developing pathologic condition.

4) To assess the size of pulp chamber and proximity to the fracture line. The relative sizes of the pulp chamber and canal should be carefully examined. Irregularities or an inconsistency in the size of the chamber or canal compared with that of adjacent teeth may be evidence of a previous injury. This observation is important in determining the immediate course of treatment.

5) Determine the stage of root development (the stage of apical development often indicates the type of treatment).

6) Presence of root fracture or alveolar bone fracture. A root fracture as a result of the injury or one previously sustained can be detected by a careful examination of the radiograph. However, the presence of a root fracture may not influence the course of treatment, particularly if the fracture line is in the region of the apical third. Teeth with root fractures in this area rarely need stabilization, and a fibrous or calcified union usually results.

7) To ascertain the position of traumatized tooth and its relationship to the unerupted teeth in the area (dislocation of the tooth). If teeth have been discernibly dislocated, with or without root fracture, two or three radiographs of the area at different angles may be needed to clearly define the defect and aid the dentist in deciding on a course of treatment.

8) Periodontal ligament condition.

9) Pre-existing pathological condition.

10) Extraoral radiographs help in diagnosis of jaw fractures, complex injuries to identify the extent and location of all injuries e.g. panoramic, oblique lateral jaw radiograph are useful in addition to the diagnostic process.

11) Soft tissue radiographs are helpful in determining displacement of tooth/teeth fragments into adjacent soft tissue.

Emergency Treatment of Soft Tissue Injury

Injury to the teeth of children is often accompanied by:

1) Open wounds of the oral tissues,

2) Abrasion of the facial tissues,

3) Puncture wounds.

The dentist must recognize the possibility of the development of tetanus after the injury and must carry out adequate first-aid measures. Primary immunization is usually a part of medical care during the first 2 years of life.

However, primary immunization cannot be assumed—it must be confirmed by examination of the child's medical record. When the child who has had primary immunization receives an injury from an object that is likely to have been

contaminated, the antibody-forming mechanism may be activated with a booster injection of toxoid. An unimmunized child can be protected through passive immunization or serotherapy with tetanus antitoxin (tetanus immune globulin, or TIG).

The dentist examining the child after an injury should determine the child's immunization status, carry out adequate debridement of the wound, and, when indicated, refer the child to the family physician. Tetanus is often fatal, and preventive measures must be taken if there is a possibility that an injured child is not adequately immunized.

Debridement, suturing, and/or hemorrhage control of open soft-tissue wounds should be carried out as indicated.

Working with an oral and maxillofacial surgeon or a plastic surgeon may also be indicated. In extensive injury the child should be hospitalized.

Note: The aim of treatment of any injured tooth is to:

1) Maintain vitality

2) Allow normal development and growth of the jaws and alveolar bone

Emergency Treatment and Temporary Restoration of Fractured Teeth without Pulp Exposure

Crown Craze or Crack: These are minute cracks extending throughout the labiolingual surface, usually resulting from direct trauma to a tooth. These crazed areas may involve enamel alone or both enamel and dentin.

A trauma to a tooth that causes a loss of only a small portion of enamel should be treated as carefully as one in which greater tooth structure is lost. The emergency treatment of minor injuries in which only the enamel is fractured may consist of no more than smoothing the rough, jagged tooth structure. However, without exception, a thorough examination should be conducted.

The patient should be reexamined at 2 weeks and again at 1 month after the injury. If the tooth appears to have recovered at that time, continued observation at the patient's regular recall appointments should be the rule.

Sudden injuries with a resultant extensive loss of tooth structure and exposed dentin require an immediate temporary restoration or protective covering (to avoid further damaging of the pulp from thermal or bacteria which can transmitted to the pulp through dentinal tubule), in addition to the complete diagnostic procedure. In this type of injury, initial pulpal hyperemia and the possibility of further trauma to the pulp by pressure or by thermal or chemical irritants must be reduced. In addition, if normal contact with adjacent or opposing teeth has been lost, temporary restoration or protective covering can be designed to maintain the arch integrity. Because providing an adequate permanent restoration may depend on maintaining the normal alignment and position of teeth in the area, this part of the treatment is **as important as** maintaining the vitality of the teeth.

Several restorations that will satisfy these requirements can easily be fabricated.

There are factors which affect the treatment:

1) The time dentin has been exposed.

2) The thickness of the dentin covering the pulp.

3) The stage of the development of the root.

If thick layer of dentin cover that pulp, a direct pulp capping is indicated to cover the dentinal tubule by Ca $(OH)_2$ and hold the medication by means of retainer. Use an orthodontic band (or one of the followings: acrylic crown (which is good for esthetic), celluloid crown, stainless steel crown, cupper ring). Then fill the gap with cement and ask the patient to come after some time to check the vitality, the mobility, and the band should stay 6-8 weeks if everything is all right then restore the teeth.

If the patient have class II # near the pulp:

✓ If the patient come immediately do pulp capping.

✓ If the patient come later on then we consider it as exposure and we do root canal filling because the thin layer of dentin left is not enough to protect the pulp from infection.

Fragment Restoration (Reattachment of Tooth Fragment)

Occasionally the dentist may have the opportunity to reattach the fragment of a fractured tooth using resin and bonding techniques. This procedure is atraumatic and seems to be the ideal method of restoring the fractured crown. Sealing the injured tooth and aesthetically restoring its natural contour and color are accomplished simply and constitute an excellent service to the patient.

The procedure provides an essentially perfect temporary restoration that may be retained a long time in some cases. It is not often that the fractured tooth fragment remains intact and is recovered after an injury, but when this happens, the dentist may consider the reattachment procedure. The tooth requires no mechanical preparation because retention is provided by enamel etching and bonding techniques. If little or no dentin is exposed, the fragment and the fractured tooth enamel are etched and reattached with bonding agents and materials.

For cases in which considerable dentin is exposed or a direct pulp cap is indicated, some controversy exists about the best treatment to enhance the likelihood of maintaining pulp vitality. Some believe that the meticulous use of bonding agents and materials to directly cap the exposed dentin and the pulp, if exposed, (i.e., the total-etch technique) is best, whereas others believe that calcium hydroxide should be applied to the exposed dentin and pulp before the bonding procedure is completed.

After the fragment was trial-seated to confirm a precise fit, the exposed dentin of the fractured tooth was covered with a thin layer of hard-setting calcium hydroxide that was allowed to remain as a sedative dressing between the tooth and restored fragment. A portion of the dentin in the fragment was removed to provide space for the calcium hydroxide. The fragment was then soaked in etchant, and the fractured area of the tooth was also etched well beyond the fracture site. After thorough rinsing and drying of all etched enamel, the fragment and the etched portion of the tooth were painted with a light-curing sealant material bonding agent was recommended.

The selected shade of composite resin was used to fill the prepared void in the fragment, and it was then carefully seated into its correct position and held firmly while the material was light-cured. Subsequent radiographs and vitality tests indicated that the tooth had probably responded favorably.

Temporary Bonded Resin Restoration

The excellent marginal seal and retention derived from the application of aesthetic restorative materials to etched enamel surfaces have revolutionized the approach to the restoration of fractured anterior teeth. These bonding techniques are highly successful and versatile in many situations involving anterior trauma. It may not be advisable to restore an extensive crown fracture with a finished aesthetic resin restoration on the day of the injury because it is usually best not to manipulate the tooth more than is absolutely necessary to make a diagnosis and provide emergency treatment. Also, such emergencies are usually treated at unscheduled appointments, and this treatment should be carried out as efficiently as possible to prevent significant disruption of the dentist's scheduled appointments. A temporary restorative resin restoration can be placed efficiently and is often the treatment of choice.

Conventional bonding procedures are used for application of the restorative resin material as a protective covering at the fracture site. As a short-term temporary restoration, it requires little or no finishing and does not need to restore the tooth to normal contour. However, the restoration should cover the fractured surfaces and maintain any natural proximal contacts the patient may have had before the injury. After an adequate recovery period an aesthetic resin restoration may be completed, often without removal of all the temporary resin material. However, the outer surfaces of the temporary restoration should be removed superficially before the new material is applied. The margins of the new restoration should extend beyond the margins of the temporary restoration and onto newly etched enamel.