

Oral and Maxillofacial surgery/Fifth year

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Dentoalveolar Injuries

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The term '**dentoalveolar injury**' describes trauma that is localized to the teeth and the supporting structures of the alveolus. These injuries can occur in isolation, or as part of a more serious maxillofacial injury.

Dentoalveolar injuries occur in all age groups but they are more common in children. Each age group has specific etiologies; in children the most common cause is fall, whereas in adolescents, contact sports and playground activities are the main cause, adult injuries are caused by RTAs, contact sports, altercations or assaults and industrial accidents. Males are more frequently involved in such injuries than females.

Factors affecting dentoalveolar injuries

- Dentoalveolar injuries can result from direct or indirect trauma.
 - ✓ With direct trauma maxillary incisors are the most frequently traumatized teeth, especially if they are associated with a Class II Division malocclusion.
 - ✓ Indirect trauma to the dentition usually results from the forceful impact of the mandible with the maxilla, following a blow to the chin region or from forceful whiplash to the head and neck. These traumas will often result in injury to the posterior teeth, anterior soft tissue or both.
- The extent of injury also depends on the energy of impact:
 - ✓ Low-velocity blow usually causes damage to the supporting dentoalveolar structures.
 - ✓ High-velocity impact usually results in crown fractures.
- It also depends on the objects:
 - ✓ Sharp objects favor crown fractures.
 - ✓ Blunt objects usually result in luxations or root fracture.
- Direction of the impacting force.

Classification

- ❖ Injuries to the hard dental tissue and pulp.
- ❖ Injuries to the periodontal tissue.
- ❖ Injuries to the supporting bone.
- ❖ Injuries to the gingiva and oral mucosa.
- ❖ Combination.

Injuries to the hard dental tissue and pulp

- ✓ **Crown infraction**; it is incomplete fracture or crack of enamel without loss of tooth substance.
- ✓ **Uncomplicated crown fracture**; which is confined to the enamel or involving the enamel and dentin without pulp exposure.
- ✓ **Complicated crown fracture**; involves enamel and dentin with pulp exposure.
- ✓ **Uncomplicated crown-root fracture**; involving enamel, dentin and cementum without pulp exposure.
- ✓ **Complicated crown-root fracture**; involving enamel, dentin and cementum with pulp exposure.
- ✓ **Root fracture**; involving dentin, cementum and pulp.

Injuries to the periodontal tissue

- ✓ **Concussion**; is an injury to the tooth-supporting structures without abnormal loosening or displacement of the tooth but with marked reaction to percussion.
- ✓ **Subluxation**; (loosening) is an injury to the tooth-supporting structures with abnormal loosening but without displacement of the tooth.
- ✓ **Intrusive luxation**; (central dislocation) is displacement of the tooth into the alveolar bone with comminution or fracture of the alveolar socket.
- ✓ **Extrusive luxation**; (peripheral dislocation or partial avulsion) is partial displacement of the tooth out of the alveolar socket.
- ✓ **Lateral luxation**; is displacement of the tooth in a direction other than axially, accompanied by a comminution or fracture of the alveolar socket.
- ✓ **Avulsion**; is a complete displacement of a tooth out of the alveolar socket.

Injuries to the supporting alveolar bone

- ✓ **Comminution of alveolar socket**; it can occur with intrusive and lateral luxation.
- ✓ **Fracture of a single alveolar socket wall**; confined to facial or lingual wall.
- ✓ **Fracture of both walls of socket or alveolus.**

- ✓ **Fracture of maxilla or mandible;** involving the alveolar bone with or without the socket.

Injuries to the gingiva or oral mucosa

- ✓ **Contusion of Gingiva or Mucosa;** a bruise is usually produced by impact from a blunt object and results in submucosal hemorrhage without a break in the mucosa.
- ✓ **Abrasion of Gingiva or Oral Mucosa;** a superficial wound produced by rubbing or scraping of the mucosa, leaving a raw, bleeding surface.
- ✓ **Laceration of Gingiva or Oral Mucosa;** a shallow or deep wound in the mucosa results from a tear and is usually produced by a sharp object.

Examination and clinical manifestations

A complete history of the mechanism and events of the injury should be obtained and a thorough clinical and radiographic examination performed quickly to ensure proper diagnosis and treatment.

Clinical examination should include an inspection of soft tissue for embedded fragments of tooth or debris. Lacerations, abrasions, and contusions should be examined and evaluated for damage to vital structures, such as the parotid duct, submandibular duct, nerves, and blood vessels.

The teeth should be examined for abnormal mobility horizontally and axially, all teeth should be accounted for at the time of examination.

Missing teeth or pieces of teeth that have not been left at the scene of the accident must be considered to have been aspirated, swallowed, or displaced into soft tissue of the lip, cheek, floor of the mouth, neck, nasal cavity, or maxillary sinus.

Dentoalveolar fractures are commonly associated with significant damage to the lips. There is often substantial bruising and swelling and there may be portions of tooth or foreign bodies embedded in the soft tissues.

The direction of tooth displacement should be noted. In the primary dentition, the dislocation of the apex of the displaced primary tooth can possibly damage the permanent successor.

The involved teeth should be tapped or percussed with the handle of a mouth mirror; pain elicited with percussion is suggestive of injury to the periodontal ligament. The sound elicited by percussion is also of diagnostic value; a sound resembling a hard metallic ring is elicited with teeth that are locked into bone, whereas a dull sound indicates a subluxated tooth.

Pulp testing during the acute phase of injury is of questionable value.

Radiographic evaluation

A single radiograph may not be sufficient to demonstrate dentoalveolar injuries, most commonly a combination of occlusal and periapical radiographs is used, it should provide the following information:

- ✓ Presence of root fractures
- ✓ Degree of extrusion or intrusion
- ✓ Extent of root development
- ✓ Size of the pulp chamber and root canal
- ✓ Tooth fragments and foreign bodies lodged in soft tissue.

A radiographic examination of the head and neck, chest, and abdomen must be performed to rule out the presence of teeth or teeth fragments within these tissues or organs.

Radiographic evaluations for foreign bodies within the soft tissues of the lips or cheeks are taken with the radiographic film placed inside the soft tissues to be examined, labial to the alveolus with a reduced radiographic exposure time is used (approximately one third of normal). Foreign bodies in the floor of the mouth are viewed with cross-sectioned occlusal radiographs and with reduced radiographic exposure time.

Treatment

Several factors need to be considered:

- Age of patient and degree of cooperation.
- If the injury involves primary or permanent teeth and the degree of root development and if the apical foramen is wide or narrow.
- Location and extent of injury.
- Residual bone support.
- Periodontal health of the remaining teeth.
- Vitality of the teeth.
- Injury to the soft tissues.

- Concomitant injuries.
- Time between trauma and treatment.

Crown infraction

Evaluation is by direct trans-illumination (directing a light beam perpendicular to the long axis of the tooth from the incisal edge). No treatment is required for cracks, vitality test should be performed at the time of diagnosis with periodic follow up.

Crown fracture

- ✓ Limited to enamel→ smoothing of the sharp edges and restoration with composite.
- ✓ Enamel and dentin→ it requires covering the exposed dentin with calcium hydroxide or glass ionomer cement as a liner and restoration with composite. Reattachment of the fractured fragment using dentin-bonding agents can be performed.
- ✓ Crown fracture with pulp exposure→ the primary aim is to preserve vitality of the pulp. Treatment is by pulp capping with calcium hydroxide liner or MTA, pulpotomy or endodontic treatment. Pulp-capping procedure should be carried out only in teeth with small exposures and those that appear within 24 hours after injury.
- ✓ Crown-root fracture→ treatment goal is to preserve the remaining root fragment to support a post and crown prosthesis if possible. Primary teeth with any type of crown-root fracture should be extracted. In uncomplicated crown-root fracture; if the fracture line is above or slightly below the cervical margin, the tooth can be restored, as with a crown fracture. If the fracture continues too apically to allow adequate restoration, extraction of the tooth may be indicated.
- ✓ Complicated crown-root fracture→ the level of the root fracture determines the treatment. Extraction is usually indicated if the coronal segment includes more than one third of the clinical root or in cases of vertical root fractures; otherwise, the tooth may be treated endodontically and restored.

Root fracture

- ✓ Root fractures in primary teeth without mobility→ can be preserved and should exfoliate normally. If there is mobility or dislocation of the coronal segment, the tooth should be removed without attempts to remove the apical fragments, which could possibly damage the permanent tooth. Normal physiologic resorption of the apical fragment can be expected. Mobile coronal fragments should be removed.

- ✓ Root fractures of permanent teeth→ the prognosis depends to a large extent on the level of fracture. A calcified or fibrous bridge occasionally results in ‘healing’ of the root, particularly if the fracture is in the apical third, but fractures that occur near the gingival level have a poorer prognosis. If the fracture is above or close to the gingival crevice, the tooth should be removed or the coronal fragment should be removed and endodontic treatment performed on the root. The root can then be restored with a post and core restoration. Fractures in the middle to apical one third of the root have a good prognosis for survival of the pulp and healing of the root fragments to one another. These fractures should be treated with repositioning (if any mobility is detectable) and firm immobilization for 2 to 3 months. During this time, bridging of the fracture with calcified tissue usually occurs, and the tooth remains vital. Other treatment options include replacement with endosseous implants. Vertical root fractures should be extracted.

Injuries to the periodontal tissue

- ✓ Concussion→ Usually no treatment is indicated other than palliative therapy, in some cases relieving the tooth from occlusal forces by grinding of the opposing tooth may be required. Periodic follow up evaluation of the pulp is necessary.
- ✓ Subluxation→ Treatment includes soft diet or occlusal adjustment to remove the tooth from the traumatic effect of occlusion. Splinting for 7-10 days is necessary. Periodic follow-up evaluations.
- ✓ Intrusive luxation→ in the primary dentition, the permanent successor develops lingual to the primary incisor. If the intruded tooth impinges on the permanent tooth, the primary tooth should be extracted immediately and as atraumatically as possible to prevent injury to the permanent tooth bud.
For permanent teeth the recommended treatment includes:

- The tooth can be allowed to erupt if the tooth is immature.
 - Immediate surgical repositioning of the tooth into its proper place in the arch can be carried out. It has been shown that there is a greater incidence of external root resorption and marginal bone loss with this technique because of additional trauma to the periodontal structures.
 - Splinting to the adjacent teeth.
 - Low-force orthodontic repositioning of immature and mature teeth can be carried out over a period of 3 to 4 weeks to allow remodeling of the bone and periodontal fibers.
- ✓ Extrusive luxation→ Treatment should be as soon as possible within the first few hours after injury. The tooth that is partially displaced out of the alveolar socket should be manipulated digitally into proper position and should be splinted with a non-rigid material for 1 to 2 weeks to allow some physiologic movement of the involved tooth so that ankylosis may be prevented. Extruded primary teeth should be removed to prevent damage to permanent teeth.
 - ✓ Lateral luxation→ is usually accompanied by comminution or fracture of the alveolar socket. The tooth and alveolar bone can typically be manipulated digitally (usually with force) into proper position and splinted to adjacent stable teeth for 2-8 weeks. If treatment is delayed more than 48 hours, it is difficult to reposition the tooth manually, orthodontic intervention maybe necessary.
 - ✓ Avulsion (exarticulation) → is an urgent situation requiring immediate action.

Factors that influence success are:

- The stage of root development; survival of the pulp is possible in teeth with incomplete root formation
- The length of time the tooth is allowed to dry; if the tooth is reimplanted within 30 minutes of avulsion, there is a good chance of successful reimplantation. For extra-alveolar periods longer than 2 hours, complications associated with notable root resorption increase greatly.
- The length of storage outside the mouth.
- The medium used and correct handling and splinting; **storage media include: saliva, saline, milk**, which is considered the best medium

because of its availability, pH compatibility to vital cells, freedom from bacteria, and function of maintaining the vitality of the periodontal ligament cells 3 hours in the postavulsion period, and **Hank's balanced salt solution (HBSS)**, which is considered to have excellent storage potential. **Water** is the least desirable storage medium because of its hypotonic environment, which can cause cell lysis.

Immediate replacement is still the ideal treatment. The involved tooth should be splinted with a semirigid splint for 7 to 10 days. Rigid splinting of reimplanted teeth increases the extent of root resorption; thus, a minimum of 1 week is sufficient. If there has been a notable concomitant alveolar fracture, a rigid splint should be used for 3 to 4 weeks.

Replanted teeth should be followed up regularly.

Injuries to the supporting alveolar wall

- ✓ Comminution of alveolar bone→ is usually associated with lateral or intrusive luxation injuries. The fractures are generally reduced with digital manipulation and the luxation injury is treated. Follow-up for evidence of root resorption of the involved teeth is indicated.
- ✓ Fractures of alveolar socket wall or alveolar process→ closed reduction of the fracture by digital manipulation, the occlusion should be checked and the involved teeth removed from the forces of traumatic occlusion. Soft tissue lacerations should be sutured and the involved teeth should be in a rigid splint for 4 weeks to allow osseous healing. Alveolar process fractures with primary teeth that are not notably displaced may not require splinting because the bone heals quickly in children. Splinting of the involved segment may be difficult in children because of the lack of sufficient tooth support. The child should maintain a soft diet for 2 weeks, with periodic follow-up examinations required to monitor pulp health. Open reduction is rarely performed in alveolar fractures unless access is required as part of the treatment of an underlying jaw fracture.

Injuries to gingiva

A copious irrigation for gingival wound is necessary, suturing may be difficult due to the friability of tissue. A suitable antiseptic mouthwash should be prescribed in the postoperative period.

Splinting techniques

Splinting provides stabilization of traumatized teeth and prevents further damage to the pulp and periodontal tissue during the healing period, allowing the attachment apparatus time to regenerate.

In most cases splints should be maintained for 10-14 days, longer periods are required for alveolar bone fractures (6 weeks) and for root fractures 2-4 months may be required. The requirements for an acceptable splint are as follows:

- ✓ It is easy to fabricate directly in the mouth, without lengthy laboratory procedures.
- ✓ It can be placed passively without force to the teeth.
- ✓ It does not contact the gingival tissue and thus cause gingival irritation.
- ✓ It does not interfere with normal occlusion.
- ✓ It is easily cleaned and allows proper oral hygiene.
- ✓ It does not traumatize the teeth or gingiva during application.
- ✓ It allows an approach for endodontic therapy.
- ✓ It is easily removed.
- ✓ It provides good esthetic results.
- ✓ It does not injure the pulp of the traumatized teeth or adjacent teeth.
- ✓ It does not interfere with intraoral radiographic techniques.
- ✓ It allows placement of a rubber dam in all types of dentition.
- ✓ It does not promote root resorption.
- ✓ It allows slight mobility so that the position of the tooth after reimplantation exerts minimal pressure between the root surface and the alveolar bone.
- ✓ It is economical and requires minimal specialized equipment.

Enamel bonded composite resin splints

It is a relatively easy, versatile method for stabilization of teeth with effective, esthetic composite resin materials. This method provides excellent stabilization and allows the patient to keep the teeth and gingiva clear because the splint is away from the periodontal tissue. The

procedure is simple and efficient, may not require anesthesia, is hygienic, and serves as definitive treatment. One disadvantage of the method is that the material may fracture because the acrylic is brittle when exposed to occlusal masticatory forces.

Etch wire composite splint

The wire should be of proper stiffness. It is used with all types of dentoalveolar trauma, luxation injuries, root fractures, autotransplantation, and alveolar fractures in which good stabilization can be obtained. This technique is esthetic, hygienic, and quick to construct, it is useful with missing teeth or in a mixed dentition in which teeth are not fully erupted and the edentulous area has to be spanned. The only teeth that might not be suitable for this type of splint are those with artificial crowns or large fillings because they cannot be etched and composite material bonded to the surface.

Cap-splints

They include metal (like Silver alloy), heat or cold-curing acrylic splints. This technique requires reduction into correct position and then accurate impression of teeth and both jaws. It provides excellent immobilization and protection of traumatized teeth.

Vacuum-formed plastic splints

Simple splints for subluxated teeth or minor alveolar fractures can also be constructed from vacuum-formed plastic. An impression is taken following repositioning of the tooth or alveolar fragment. A thin plastic veneer splint is then vacuum-formed in the laboratory. The splint can be self-retaining but is usually fixed with a zinc oxide based cement or cold-cure acrylic resin, although individually chipped or fractured teeth should be covered with calcium hydroxide. This type of splints may compromise oral hygiene leading to gingival inflammation and interference with healing of the traumatized tissues.

Orthodontic appliance

Edgewise brackets and arch wire can be used to provide support for traumatized teeth but they must be passive.

Arch bars

They are used for stabilization of alveolar process fractures if the teeth within the segment are stable and can also be used for supporting subluxated teeth, but they are not recommended for tooth fixation because the tied wire tends to loosen with time and rest on the marginal gingiva, causing mechanical irritation and a site for bacterial deposition. If the teeth are mobile, the supporting wires, if positioned apically to the cervical prominence, may have a tendency to elevate the tooth slowly.

Interdental wiring techniques

They can be used but are technically difficult and troublesome. The patient may have difficulty in cleaning around the wires and the wires may slip apically below the cervical prominence of the tooth and elevate the tooth or damage the cementum surface.

- **Figure-of-eight wiring** → using soft stainless steel wires around the abutment teeth and the subluxated tooth in a figure of eight manner. They can be used a temporary form of immobilization.
- **Loop wiring** → it provides slightly better immobilization for the subluxated teeth. A length of wire is passed as a single loop around the cervical margins of the subluxated and adjacent teeth, this loop is loosely tightened, then individual wires passing interdentally above and below the loop wire are tightened, finally the original loop wire is twisted tightly.

Complications

- ✓ Traumatized teeth may develop pulpitis or become devitalized and with time this frequently leads to the development of apical infection. Such teeth can be treated endodontically.
- ✓ Discoloration of traumatized teeth which is mostly internal, it results either from **canal obliteration** caused by laying down of tertiary dentine leading to yellow discoloration or **pulp necrosis** which is caused by penetration of the dentine tubules by noxious by-products leading to grey discoloration, it usually worsens with time.
- ✓ Local gingivitis is inevitable when fixation involves interdental wires or arch bars. Applying too much interdental force to individual teeth from wires can lead to periodontal problems, the lower incisors are most vulnerable and may be partially extruded or even lost. The

complication can be avoided by spreading the load more widely and evenly and by avoiding the application of wires to suspect teeth.

- ✓ Untreated alveolar fractures either unite in an incorrect position or become infected often with sequestration of detached fragments of bone.
- ✓ Tooth fragments or foreign bodies embedded in the lip usually heal over and remain as hard lumps that may become infected.
- ✓ Root resorption which can be external or internal; external root resorption occurs on the outer surface of the root usually as a result of an inflammatory stimulus. Internal resorption takes place within the root canal system and is less common than external root resorption.
- ✓ Ankylosis is a common consequence of severe dental trauma. The tooth substance at the area of damaged periodontal ligament and cementum is progressively replaced by bone. Avulsed and re-implanted teeth with extended extra-alveolar dry time and closed apices are particularly susceptible to ankylosis. Rigid stabilization of teeth may predispose to ankylosis and external root resorption. Physiologic movements of the tooth are thought to promote fibrous (desired) attachment instead of osseous attachment of the root to alveolar bone (ankylosis).

Soft tissue injuries

Soft tissues include all the non-bony structures: skin, fat, muscle, nerves and blood vessels. The general health and quality of the soft tissues are key elements in gaining a satisfactory outcome.

Soft tissue facial injuries can be in the form of: abrasions, contusions, lacerations or a combination.

Abrasion

It is a superficial wound that usually denudes the epithelium, and occasionally involves deeper layers, it is caused by friction between an object and the surface of the soft tissue, and it can be caused iatrogenically. Abrasions are painful because they involve the terminal endings of many nerve fibers. Bleeding is usually minor because it is from capillaries and responds well to application of gentle pressure.

If the abrasion is not deep, re-epithelialization occurs without scarring. When the abrasion extends into the deeper layers of the dermis, healing of the deeper tissues occurs with the formation of scar tissue, and some permanent deformity can be expected.

Management of abrasions consists of thorough cleansing to remove foreign material. All particles of foreign matter must be removed. If these particles are allowed to remain within the tissue, a permanent "tattoo" that is difficult to treat results. Deep contaminated abrasions may require anesthesia and a surgical scrub brush to remove the debris completely. Once the wound is free of debris, topical application of an antibiotic ointment is adequate treatment. A loose bandage can be applied if the abrasion is deep but is unnecessary in superficial abrasions. Systemic antibiotics are not usually indicated.

Re-epithelialization occurs under the eschar, which is a crust of dried blood and serum that develops after an injury to soft tissue (e.g., a scab), the eschar will then drop off.

Contusion

Also called bruise results from subcutaneous or submucosal hemorrhage without a break in the soft tissue surface, it indicates that tissue

disruption has occurred within the tissues usually caused by blunt trauma.

Contusions usually require no treatment. Within several days the body resorbs the hemorrhage formed within a contusion and areas of ecchymosis caused by extravasation of blood into the skin or mucosa will change in color from purplish discoloration to blue, green, and yellow before fading.

Laceration

It is a tear in the epithelial and subepithelial tissues caused most commonly by a sharp object such as a knife or a piece of glass. If the object is not sharp, the lacerations created may be jagged. The depth of laceration may involve the external surface only, but others may extend deep into tissue, disrupting nerves, blood vessels, muscle, and other major structures.

Management involves four major steps:

1. Cleansing of the wound; to remove debris by copious irrigation with normal saline, a brush may be needed.
2. Débridement of the wound; refers to the removal of contused and devitalized tissue from a wound and the removal of jagged pieces of surface tissue to enable linear closure. In the maxillofacial region, which has a rich blood supply, the amount of debridement should be kept to a minimum.
3. Hemostasis; it may necessitate ligation or cauterization
4. Closure of the wound; the goal is proper positioning of all tissue layers from inside out. Resorbable sutures should be used to close the muscle layer or layers, after which the mucosa and/or skin is sutured. The wound edges should be well aligned to prevent unsightly scar.

Systemic antibiotics (e.g., penicillin) should be considered in deep and full thickness lacerations; otherwise the dermal surface should then be covered with an antibiotic ointment. Facial skin sutures should be removed 4 to 6 days postoperatively; adhesive strips can be placed at the time of suture removal to give external support to the healing wound.

Facial wounds of special significance

1. Any wound with tissue loss such as missile injuries are usually not suitable for primary repair because of tissue necrosis and contamination.
2. Animal and human bites. The bacterial and saliva contamination of these injuries interfere with healing and repair may need to be modified.
3. Shelved wounds such as those produced by glass fragments.
4. Lacerations of the eyelids particularly those involving the lacrimal canaliculi.
5. Lip lacerations involving the red margin, where accurate realignment of both the muscle layer and the vermilion is critical.
6. Cheek lacerations transecting major branches of the facial nerve or parotid duct.