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Endodontic Considerations in Dental Trauma

A project submitted.

To the college of Dentistry, Ashur University in partial fulfillment of the requirements for the Degree of bachelor's in dental surgery (BDS).

By

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((وَقُل رَّبِّ زِدْنِي عِلْمًا))

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Dedication

After an academic journey filled with many challenges, I dedicate the joy of my graduation to my late father, may he rest in peace. Though he has departed, my heart carries prayers for him, and my soul is filled with longing and sorrow. Here I am, sharing this moment with him, hoping that my feelings reach him and that he takes pride in those who bear his name, proving that he was the best mentor, the best teacher, the best father, and the most cherished loss.

To my siblings, whose support had a profound impact during many obstacles and hardships.

To all my esteemed professors, who never hesitated to extend a helping hand.

I dedicate this research to you.

Acknowledgement

First of all, my deepest gratitude goes to Allah, the Compassionate, the Most Merciful, and the Lord of all creations.

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Words remain incapable of expressing our gratitude and obligation to our family, who always bestow us of unbounded love and support throughout our life, and provided us with the opportunity to reach this goal of our study.

Certification of the Supervisor

I certify that this project entitled ." Endodontic considerations in dental trauma" was prepared by the fifth-year student "Tabark Hussein faisal" under my supervision at the College of Dentistry/Ashur University in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Signature:

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Date: / / 2025

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List of Abbreviations

Abbreviation	Full Form
TDI	Traumatic Dental Injuries
CBCT	Cone Beam Computed Tomography
LDF	Laser Doppler Flowmetry
IADT	International Association of Dental Traumatology
VPT	Vital Pulp Therapy

Introduction

Dental trauma is a public health problem in all societies that reaches a large number of people. The international association of dental traumatology reports that one out of every two children sustain dental injury. The traffic accident, fall, playing , sporting activities, has contributed to the establishment of traumatic dental injury as a public dental health problem, in addition, the remarkable decline of the prevalence and severity of dental caries amongst the children in many countries may have made a traumatic dental injury the most serious public dental health problem among youth in those countries. (Avery, 2000; McDonald and Avery, 2004).

Traumatic dental injury may vary in its severity from a simple enamel fracture which is the most prevalence type to multiple types of trauma affecting both soft and hard tissue, and even it may reach to complete avulsion of the tooth. (Noori, 2007).

Dental injury of primary teeth has been found to be responsible of complicated problems to underlying permanent teeth such as, hypoplasia, dilacerations, delay eruption time and tooth malformation. injury to the permanent teeth may cause long lasting cosmetic, functional problem, in addition to psychological defect for the parent and patient himself. (Whitworth, 2005; Sennhenn-Kirchner and Jacobs, 2006).

Many studies have been conducted throughout the world concerning prevalence and severity of traumatic injury which has been found to be affected by many variables as age, gender, cause of trauma, in addition to lip position, protrusion, type of occlusion, abnormal child behavior. (Cortes, 2000).

In Iraq, many studies had been conducted on the traumatized anterior teeth from the beginning of the 1980, some of them were epidemiological studies. (Baghdadi et al, 1981; yagot et al, 1988; EL- Samarria, 1989; al-sayyab, 1992; al-hayali, 1998; al-obaidi and al- Geburi, 2002; AL-Kassab, 2005; Noori, 2007), other was clinical concerning management of emergency cases in hospital (EL-Samarria, 1995).

Aim of the Study

This study aims to evaluate endodontic considerations in dental trauma, focusing on the diagnosis and management of soft tissue injuries, various types of tooth fractures, and appropriate treatment techniques such as reattachment and pulpotomy. It seeks to provide clinical guidelines to improve prognosis and ensure effective long-term management of traumatized teeth.

Chapter One

Endodontic Considerations in Dental Trauma

1.1 Soft tissue injuries

In Dental Trauma Soft tissue injuries are a significant part of the management in dental trauma cases.

These injuries involve the non-bony tissues, such as the gums, lips, cheeks, and tongue, and often occur due to direct trauma caused by accidents, sports injuries, or falls. Prompt assessment and treatment are essential to minimize complications and ensure proper healing. (Michacl, 2001)

1. Types of soft tissue injuries in dental trauma:

Lacerations: These injuries occur when soft tissues are torn or cut due to a sharp impact. Lacerations may involve the gums, lips, or the tissues around the teeth.

Contusions (Bruises): Result from a direct blow to the area, causing internal bleeding under the skin, which leads to swelling and discoloration.

Swelling: Swelling is a common symptom of soft tissue injuries, caused by fluid or blood accumulation in the affected area.

Muscle or ligament strains: Injuries to the muscles or ligaments supporting the teeth or jaw can occur due to significant trauma. (Andreasen, 2011).

2 Causes:

a- Sports injuries such as football, hockey, or contact sports.

b- vehicle accidents or sudden falls.

c- Exposure to sharp objects or hard surfaces.

d- Direct trauma to the mouth or face, such as a blow to the face. (Andreasen, 2011).

1.2 Tooth fracture

Tooth fractures occur predominantly in children and young people, accounting for 5% of all traumatic dental injuries. Management of tooth fracture requires an accurate diagnosis, treatment planning, and regular follow-ups. Tooth fractures mostly involve front teeth in the upper jaw because of their position in the oral cavity. The most common causes are sports activities, traffic accidents, and physical violence Depending on the event's intensity, the tooth may be chipped off, partially or completely dislocated, or even knocked out of the oral cavity. Tooth fractures require prompt treatment for restoring their function and cosmetic. (Diangelis, 2017)

Etiology:

Traumatic dental injuries are caused by either a direct or indirect impact. The severity of the damage results from the energy, direction, and shape of the impacting object and the response of the tissues surrounding the tooth. Falls are the most common etiology for dental trauma, accounting for up to 65% of cases, followed by sports injuries, cycling accidents, motor vehicle accidents, and physical violence. The prevalence of lesions associated with sports and violence increases with age, the former being more frequent in teenagers and the latter in 21 to 25-year-olds.By contrast, falls and collisions are the most common cause of dental trauma in primary dentition. Dental caries are a predisposing factor for tooth fracture even after the slightest of trauma. Patients with increased overjet or lip incompetence are much more likely to suffer traumatic injuries in the upper incisors. (Zaleckiene, 2014)

Epidemiology :

Oral traumatic injuries in all age groups; however, they are responsible for approximately 17% of total injuries in children. they are more frequent in males than females. More than 75% of tooth fractures are in the upper jaw, and more than half of these involve central incisors, followed by lateral incisors and canines. The maxillary central and lateral incisors are the most frequently fractured teeth because of their anatomic position in the oral cavity. Single tooth fractures are more commonly observed than multiple teeth fractures, but if they occur, they tend to result from sports injuries, traffic accidents, and physical violence. Permanent dentition is more commonly affected by dental trauma than primary dentition. The prevalence of tooth fractures in deciduous teeth ranges from 9.4% to 41.6% and 6.1% to 58.6% in permanent teeth. (Zaleckiene, Peciuliene, Brukiene, 2014)

1.3 Enamel fractures

An enamel fracture is when the outermost layer of the tooth is cracked, without damaging the inner layers including the dentine or pulp. This can happen from trauma such as a fall where the teeth are impacted by a hard object causing a chip to occur (Feldens & ET AL, 2020).

Enamel fracture of central incisor tooth on the incisal, biting, surface

The term “craze lines” and "enamel infraction" are also used to describe minute incomplete cracks exclusive to the enamel surface(Feldens & ET AL, 2020). An enamel fracture occurs when the outer layer of the tooth, known as enamel, is fractured without directly impacting the underlying tooth tissues of the dentine or pulp, this phenomenon typically arises from hard, external forces impacting the tooth to induce enamel breakage. These fractures are often characterised by irregular breaks on the biting surface of the tooth, in contrast to the smoother surfaces associated with typical tooth degradation. Enamel fractures can vary in severity, ranging from minor cosmetic issues to more significant structural problems. an enamel fracture typically doesn't cause any noticeable symptoms such as tenderness

or an increase in mobility. However, if sensitivity and mobility are present, it may indicate an enamel-dentine fracture or a root fracture. (Zadik, Levin, 2009).

Figure 1. Enamel fracture.

1.4 The technique for reattachment:

The fractured tooth surface and the fragment will be subjected to acid etching with 37% orthophosphoric acid (3M ESPE) for15 seconds, then rinsed thoroughly with water and air dried. Next, an adhesive (Adper Single Bond, 3M ESPE) will be applied on to the etched surfaces and the resin cement (Panavia F) is manipulated according to the manufacturer's directions and applied to the repositioned fragment and tooth surface(Garcia& ET AL,2018).

1.5 Uncomplicated-crown fractures

confined to enamel and dentin without pulp exposure. A clinical TDI (traumatic dental injurie) examination should have good lighting and transillumination to evaluate teeth for fractures and infractions (Paulina & Jain, 2024).

Types of Uncomplicated Crown Fractures:

1. Enamel fractures: These are the most common type and occur when the enamel is chipped or cracked due to impact or excessive pressure
2. Dentin fractures: These fractures go deeper than enamel and may cause discomfort if they expose the sensitive dentin layer near the pulp**.** (Andreasen, 2007)

Symptoms:

• Mild pain or sensitivity.
• Visible crack or break in the tooth.
• No bleeding or swelling**.**

Figure 2. Uncomplicated crown fracture.

1.6 Complicated crown fracture

Traumatic dental injuries (TDIs) concern mostly children and young adults. complicated crown fractures (enamel–dentin fractures with pulp exposure), and crown–root and root fractures. Most of the cases of dental injuries involve anterior teeth, especially the maxillary upper incisors. Conversely, lower central incisors and upper lateral incisors are less commonly involved.

Crown fractures, with or without pulp exposure, are the most common type of trauma in permanent dentition. Complicated crown fractures involve enamel and dentin with pulp exposure; the occurrence of such trauma ranges between 2% and 13%, and the most common causes are falls, traffic accidents, domestic violence, fights, and sports (Radwanski& ET AL, 2022).

The treatment of complicated crown fractures according to the International Association of Dental Traumatology (IADT, 2020). includes conservative treatment of the pulp, such as partial pulpotomy, in both mature and immature roots. It is worth emphasizing that the condition of the pulp before starting treatment should be determined. However, in the case of tooth injuries, it is possible to obtain false negative results, meaning no response despite vital pulp.

After the trauma, the nervous response is temporarily lost, so the sensibility test (cold test and electric pulp test) may be negative. Nevertheless, it is recommended that pulp vitality testing is performed after injury, as well as at follow-up visits, to assess any possible change over time. In addition, tests for the evaluation of blood flow in the pulp, such as laser Doppler flowmetry (LDF), should be used(Radwanski& ET AL, 2022).

During diagnosis, it is strongly recommended to take a parallel periapical radiograph. Additional radiographs are required if there are signs and symptoms of other potential injuries. For soft tissue injuries, X-rays of the lip and/or cheek are needed to look for tooth fragments or external debris. In the event of suspicion of other injuries, especially root fractures, crown–root fractures, or lateral luxations, the clinician should consider using cone beam computerized tomography (CBCT). This examination enables the determination of the location, extent, and direction of the injury. The decision on additional patient exposure to radiation should be based on the fact that the obtained results will change the route of injury management (Fidel & ET AL, 2006).

When a tooth fragment is available, it should be reattached; if it is not available, it is recommended to cover the dentin with a glass-ionomer or a bonding agent and composite resin. If a post is required to retain a crown in a mature tooth with complete root formation, root canal treatment is the preferred method (Fidel & ET AL, 2006) .

The favorable outcomes include asymptomatic teeth with positive response to pulp sensibility testing, good quality restoration, and continued root development in immature teeth. Treatment outcome depends on the severity of the injury, quality, and timeliness of initial care, and recall protocol (after 14 days, 6–8 weeks, 3 and 6 months, and one year after the injury). The latter was performed via radiographic assessment and cold/hot vitality test. The present case report aimed at showing a possible conservative treatment after complicated tooth fracture that consisted of partial pulpotomy followed by adhesive reattachment of the tooth fragment (Radwanski& ET AL, 2022).

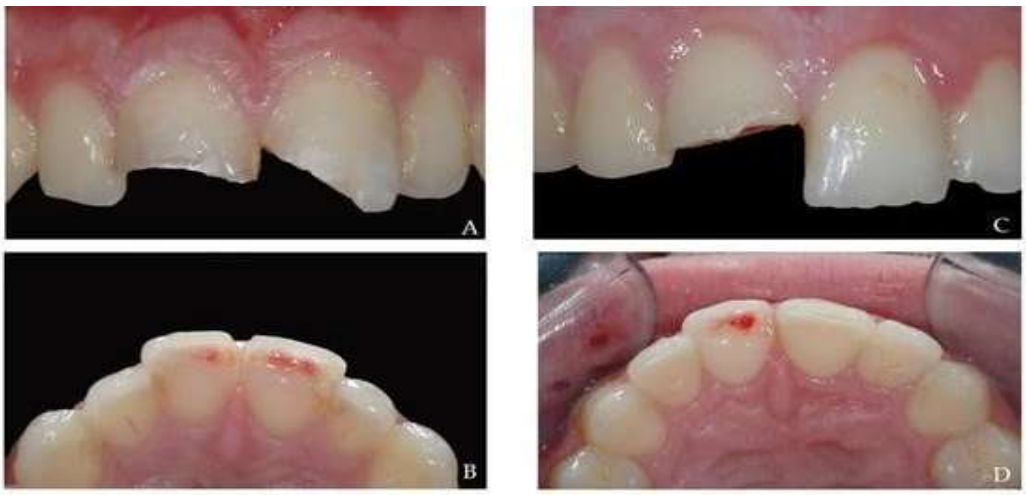


Figure 3. Intraoral photographs of fracture tooth.

Table 1: Difference Between Complicated and Uncomplicated Crown Fracture		
Feature	**Uncomplicated crown fracture**	**Complicated crown fractur**
Affected Parts	Enamel and dentin only	Enamel, dentin, and pulp exposure
Pulp Exposure	No	Yes
Pain/ Sensitivity	Mild sensitivity to temperature or air	Severe pain due to pulp exposure
Treatment	Bonding, filling, or crown	Root canal treatment followed by restoration

Pulp Treatment Option

diagnosis of injured tissue plays a key role, which can often be difficult in the case of trauma. Additionally, the tests used for sensitivity assessment (electric and/or thermal stimulation), which are dependent on neural response, may not be reliable in the first days after trauma. In the case of difficulties, tests based on the measurement of actual blood flow, such as LDF or pulse oximetry, are recommended. The increasing time between injury and intervention contributes to lower treatment success. The age of the patient, and, thus, root development, does ontains more fibrous than cellular elements, which means that it has less repair capacity. Currently, it is thought that more important factor for treatment success is the complete removal of infected tissue, and, therefore, biological methods can be successfully applied to elderly individuals. However, the presence of a further injury (e.g., luxation) associated with the crown fracture may adversely affect the outcome of the treatment. The pulp exposed due to trauma, compared to carious exposure,

has a greater chance of healing. The extent of pulp exposure does not affect treatment prognosis, provided that it remains vital (Duncan, 2022).

It is important to consider that the success of VPT is also influenced by factors such as proper infection control (rubber dam isolation), bleeding control, selection of the capping material providing a tight seal, and a final restoration(Duncan, 2022).

1.7 Pulpotomy

pulpotomy is a dental procedure in which the pulp in the crown of a tooth is removed in order to save the tooth from infection or decay. Pulp is found in both the roots and the crown of a tooth and is the soft tissue that is comprised of nerves and blood vessels. It is most often performed on decidues teeth in children, but can be successful for adult teeth as well. the dentist may recommend a pulpotomy if the pulp tissue has been exposed to decay or infection or if it has severe cavity. (Ranly, 1994).

Pulpotomy steps

Before the procedure begins, the child will be able to get comfortable in the dental chair and they might be able to watch something if there is a TV in the room (Ranly, 1994).

1.Administering local anaesthetic

Topical anaesthetic will be applied over the gums in the form of a gel, before local anaesthetic is injected into the gums. The topical anaesthetic is used to make this injection more comfortable. In some cases, the child may need to be sedated. (Ranly, 1994).

2.Tooth decay removal

A rubber dam will be placed into the Patients mouth to make it easier to work on the tooth in question by limiting saliva and reducing the chance of accidentally swallowing something. The dentist will then remove any tooth decay on or around the tooth (Wilson& ET AL, 2021).

3. **Open pulp chamber**

The dentist will drill through the enamel to open the pulp chamber. At this point the dentist can only continue with the procedure if the pulp is healthy. If the pulp is not bleeding or there's no pulp then a pulpectomy or tooth extraction may need to be performed instead (Tjäderhane & ET AL, 1995).

4. **Pulp tissue removal**

The inflamed pulp will then be removed and cotton swabs will be used to stop the bleeding (Claus& ET AL, 2004).

5. **Dental crown placement**

The remaining pulp in the roots will then be treated and covered to protect it, and the pulp chamber will be sealed and restored. A filling or a stainless steel crown may be used for thispulp tissue in your tooth has been exposed to decay or infection or if it has a severe (Aquilino & Caplan, 2002).

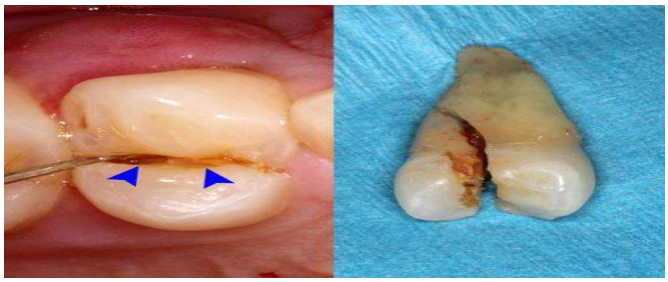
Figure 4. Preoperative photograph showing fractured.

1.8 Crown-root fracture

A crown-root fracture is a type of dental trauma, usually resulting from horizontal impact and represents 5% of all dental injuries. These fractures involve enamel, dentin and cementum, occurring below the gingival margin. Depending on the presence or absence of pulpal involvement, they are classified as complicated or uncomplicated fractures.A crown-root fracture often involves the biologic width. Biologic width is the sum of the lengths of epithelial and connective tissue attachment to the tooth (Das & Muthu, 2013).

Tooth fracture, besides the pain from the injury, causes psychological stress in children due to missing tooth structure. Primary goal of the treatment remains esthetic and functional rehabilitation. Several therapeutic procedures are available for fractured anterior teeth.

Figure 5. Crown – root fracture.



However, reattachment of the fractured fragment is an excellent biological approach for restoration, when the fragment is available. Tooth fragment reattachment (biological restoration) offers the advantage of being simple, less time consuming, and conservative technique. The rate of incisal edge wear is similar to that of adjacent teeth. They provide natural esthetics in the form of color, morphology, and translucency match and acceptable by the patients with psychological benefits. The purpose of this case report is to describe biological restorative treatment in a maxillary central incisor with complicated crown-root fracture and involving the biologic width (Das & Muthu, 2013).

1.9 Root fracture

Root fracture of the tooth is a dentine cementum fracture involving the pulp. Traumatic root fracture occurs most often in the middle third of the roots of fully erupted and fully formed teeth. However, root treated teeth are more susceptible to root fracture, as this involves removing root dentine, thereby weakening the tooth. Principles of operative dentistry. (Qualtrough, 2005)

1.9.1 Vertical root fracture

Vertical Root Fractures are longitudinally orientated fractures of the root. They extend from the root canal to the periodontium. They are usually seen in root filled teeth, however they can also be seen in non-restored teeth.

The fractures can involve the whole length of the root or only a section of it. When un-recognised they lead to frustration and inappropriate endodontic therapy. The time between a root filling and a fracture is around 39 months, but they can occur during the treatment. (Moule, kahler, 1999)

1.9.2 Horizontal root fracture

Horizontal root fracture is when the fracture line is perpendicular or oblique to the long axis of the tooth. It can occur in the apical, middle or coronal portion of the root. horizontal root fracture accounts for only 3% of all dental injuries.

Detection

Horizontal root fractures can often be identified by taking a peri-apical radiograph.

Now, with the introduction of cone beam computed tomography (CBCT), it is possible to view root fractures three-dimensionally.

Treatment

The treatment of horizontally root-fractured teeth involves re-positioning, stabilisation and occlusion adjustment, with a good chance of survival.

The exception to this is when the horizontal fracture affects the coronal third of the root, in which case extraction is necessary in 80% of cases. In this case of pulpal necrosis, which occurs in 20-44% of root fracture cases,this can be treated through root canal treatment or endodontic surgery(Churlinov, 2019).

When the coronal fragment of the tooth is stable, then splinting is unnecessary. However, in the case that the fracture affects the coronal third of the root, is in close-proximity to the cemento-enamel junction, and it is almost impossible to prevent the contents of the oral cavity contacting the fracture, then splinting for at least 2 months is required. (Churlinov, 2019).

Chapter Two

Conclusion

Dental trauma is a common health issue that affects function, aesthetics, and psychological well-being, particularly in children and young adults. These injuries range from minor enamel fractures to pulp exposure or complete tooth loss, requiring prompt intervention and precise treatment to preserve oral health and prevent complications ، Successful management depends on early diagnosis and immediate treatment, utilizing advanced technologies such as cone beam computed tomography (CBCT) and pulp vitality tests to assess the extent of the damage and determine the most appropriate approach, whether pulpotomy or root canal therapy ، In addition to treatment, prevention plays a crucial role in reducing the incidence of dental trauma. This includes using mouthguards during sports, implementing safety measures to prevent accidents, and raising awareness about the importance of oral health care ، To improve outcomes, continuous research and development are essential to enhance treatment techniques and strengthen preventive programs. This will help minimize the long-term impact of dental injuries and ensure effective care and a better quality of life for affected individuals.

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