

Review Article

Endodontic Emergencies: An Overview

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ABSTRACT

Endodontic emergencies are a challenge in both diagnosis and management. Incorrect diagnosis or incorrect treatment will fail to relieve pain and in fact, may aggravate the situation. Irritation of periradicular tissues results in inflammation and the release of a group of chemical mediators that initiate inflammation. Release of these substances causes pain either directly by lowering the response threshold of the sensory nerve fibres or indirectly by increasing vascular permeability and producing oedema. The aim of emergency endodontic treatment is to relieve pain and control any inflammation or infection that may be present. Absolute attention to the patient's chief complaint, properly gathering the clinical data and rendering the appropriate treatment to remove the causative etiology will ensure proper management of endodontic emergencies.

Keywords: Endodontic emergencies, diagnosis, pulp pain, management

INTRODUCTION

Endodontic emergencies are a challenge in both diagnosis and management. Incorrect diagnosis or incorrect treatment will fail to relieve pain and in fact, may aggravate the situation. Investigations into the role of host factors (age, gender, tooth type, and so on) contributing to occurrence of endodontic emergencies have been inconclusive, a clear cut cause and effect relationship has not been established. Endodontic emergency is defined as the condition associated with pain and/or swelling which requires immediate diagnosis and treatment. The main causative factors responsible for occurrence of endodontic emergencies are pathosis in pulp, periradicular tissues and traumatic injuries^[1]. Irritation of periradicular tissues results in inflammation and the release of a group of chemical mediators that initiate inflammation.

Mediators released include vasoactive amines, arachidonic acid metabolites, neuropeptides, fibrinolytic peptides, anaphylatoxins and kinins. The concentration of some of these substances in pulp and periradicular tissues are significantly higher in symptomatic than asymptomatic lesions. Release of these substances causes pain either directly by lowering the response threshold of the sensory nerve fibres or indirectly by increasing vascular permeability and producing oedema. Oedema results in increased fluid pressure, which directly stimulates pain receptors.

PHYSIOLOGY OF PAIN

The sensory system of the pulp appears to be well suited for signalling potential damage to the tooth. The tooth is innervated by a large number of A (myelinated) and C (unmyelinated) nerve fibers. These include both sensory afferent fibers and sympathetic fibers that modulate pulpal blood flow. In the peripheral pulp, branches of the sensory nerves give rise to an interlacing network of fibers known as the subodontoblastic plexus. From this plexus nerve fibers extend to the odontoblastic layer, predentin, and dentin and terminate as free nerve endings. During inflammation of peripheral tissues, numerous mediators are produced by endothelial cells, resident cells, and leucocytes that are recruited to the site of injury. Many of

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these mediators (e.g. protons, cytokines, and nerve growth factor) are known to elicit pain by activation of specialized primary afferent neurons called nociceptors. Nociceptors are defined as “neurons preferentially sensitive to a noxious stimulus or to a stimulus which would become noxious if prolonged”. Nociceptors belong to the group of unmyelinated A delta and C fibres originating from the trigeminal and dorsal root ganglion. A delta and C fibres transduce noxious stimuli into action potentials and propagate these to the dorsal horn of the spinal cord. Various neurotransmitters modulate these signals at the level of the spinal cord and later at supraspinal sites. Together with environmental and cognitive factors, the sensation of pain is eventually elicited.^[2]

Diagnosis and treatment planning

The importance of correct diagnosis and treatment planning must not be underestimated. There are many causes of facial pain and the differential diagnosis can be both difficult and demanding. All the relevant information must be collected which include case history, medical history, patients complaint, clinical examination, extra-oral examination, intra-oral examination, diagnostic tests, palpation, percussion, mobility and radiography.^[3]

CLASSIFICATION OF ENDODONTIC EMERGENCIES

According to Grossman^[4]

1. Before treatment

- a. Endodontic emergencies presenting pain and / or swelling:
 - Cracked tooth syndrome
 - Symptomatic reversible pulpitis
 - Symptomatic irreversible pulpitis
 - Symptomatic apical periodontitis
 - Phoenix abscess
 - Acute alveolar abscess
 - Cellulitis
- b. Traumatic injuries
 - Crown /root fractures
 - Luxation injuries
 - Tooth avulsion

2. During treatment

- Hot tooth
- Endodontic flare ups

3. After treatment

- Post-obturation pain
- Vertical root fracture

PRE-TREATMENT EMERGENCIES

Dentin Hypersensitivity

“Dentine hypersensitivity is characterized by short, sharp pain arising from exposed dentine in response to stimuli, typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other dental defect or pathology”.^[5] It is a painful clinical condition with an incidence ranging from 4 to 74%

Treatment: Two principle treatments are plug the dentinal tubules preventing the fluid flow and desensitize the nerve making it less responsive to stimulation.

Symptomatic Reversible Pulpitis

Reversible pulpitis is mild inflammation of the tooth pulp caused by caries encroaching on the pulp. Pain is triggered by hot, cold, and sweet stimuli, lasts for a few seconds, and resolves spontaneously. If the cause can be removed, the pulp should revert to a non-inflamed state and the symptoms should subside. Conversely, if the cause remains, the symptoms may persist indefinitely or the inflammation may become more widespread, eventually leading to an irreversible pulpitis.

Treatment consists of placing a sedative dressing or packing containing zinc oxide and eugenol in or around the tooth. If the pulp can be protected from further thermal shock, it may revert to a non-inflamed state.

Symptomatic Irreversible Pulpitis

By definition, the pulp has been damaged beyond repair, and even with removal of the irritant it will not heal. The pulp may progressively degenerate, causing necrosis and reactive destruction. Ideally, the treatment for irreversible pulpitis is pulp extirpation followed by cleaning and preparation of the root canal system. The pain should be

managed with appropriate analgesia such as a nonsteroidal anti-inflammatory drug (NSAID).

Symptomatic Apical Periodontitis

Apical periodontitis is an inflammation and destruction of periradicular tissues. It occurs as a sequence of various insults to the dental pulp, including infection, physical and iatrogenic trauma, following endodontic treatment, the damaging effects of root canal filling materials.^[6]

Management

- Pharmacotherapeutics included systemic therapy (antibiotics, corticosteroids, and NSAIDs or analgesics).
- Local therapy (irrigants, intracanal medicaments).
- Surgical measures encompassed the establishment of drainage either through the tooth (pulpectomy, open or closed) or bone (trephination).
- Extraction.
- Occlusal adjustment.

Acute Alveolar Abscess

Acute apical abscess is defined as "an inflammatory reaction to pulpal infection and necrosis characterized by rapid onset, spontaneous pain, tenderness of pressure, pus formation and swelling of associated tissues".^[7] This disease is formed when infection contacts the periapical tissues through the apical foramen and an acute inflammatory response is induced followed by pus formation. It is considered one of the most common causes of dental emergency.

Treatment involves incision for drainage and root canal treatment or extraction of the involved tooth to remove the source of infection. The selective occasions when antibiotics are indicated in cases of acute apical abscesses include the following: abscesses associated with systemic involvement, including fever, malaise, and lymphadenopathy.

Phoenix Abscess

A phoenix abscess is a painful condition due to the exacerbation of an existing lesion, like a cyst or granuloma, around the apex (tip) of a tooth's root. A phoenix abscess can occur immediately following a root canal therapy or as the result of inadequate debridement during other endodontic treatment.

This condition is difficult to correct. Often the dentist must re-perform root canal therapy on the tooth. This consists of irrigation, improved debridement of the root canal, and drainage through the canal or a surgical trephination (a puncture through soft tissue and bone over the root apex). In severe cases the dentist will prescribe antibiotics to eradicate infection.

Cracked Tooth Syndrome

Cracked tooth syndrome may be defined as a fracture plane of unknown depth, which originate from the crown, passes through the tooth structure and extends subgingivally, and may progress to connect with the pulp space and/or periodontal ligament.^[8] It denotes incomplete fracture of tooth with vital pulp. The fracture involves enamel and dentin often involving the dental pulp.

The treatment of a cracked tooth depends on the site, direction, size or the degree of the crack. Superficial cracks are easy and early to detect, and hence simple to manage. Minor cracks are often restored with a filling or a crown. Deep cracks with pulp involvement require root canal treatment and a crown to protect the tooth. In the worst case scenario, a cracked tooth cannot be repaired. These cases require the removal of the tooth and replace with a dental implant or a dental bridge.

Traumatic Injuries

One of the greatest assets a person can have is a "smile" that shows beautiful, natural teeth. An untreated and unsightly fracture of an anterior tooth can affect the behavior of a child, his progress in school, and can have more impact on their daily living. Studies reported frequencies ranging from 9.4%-41.6% in primary dentition.^[9] Traumatic injuries in permanent teeth have been reported to have a prevalence rate between 6.1% to 58.6%. Most of traumatic injuries occur at the age between 8-15 years, as during this period there is maximum physiological growth and development and children are actively involved in lot of outdoor activities.

Crown Fractures

Crown fractures comprise the most frequent injuries in the permanent dentition. Apart from

the loss of hard tissue, this injury can represent a hazard to the pulp. The usual cause of a crown fracture is a frontal impact, the energy of which exceeds the shear strength of enamel and dentin. The tooth is thereby fractured in a horizontal pattern following the course of the enamel rods.

Treatment principles of crown fractures imply the following:

Fractures of enamel depending on the site and extent of fracture: Selective grinding of the incisal edge and possibly of the adjacent tooth to reestablish symmetry and acid-etch composite restoration.

Fractures of enamel and dentin: Dentinal coverage can include a calcium hydroxide base followed by dentin bonded composites and glass ionomer cements or bonding of the enamel-dentin crown fragment.

Pulp exposures: The exposed pulp can usually be treated successfully (i.e. by the formation of a calcified bridge) by pulp capping and partial pulpotomy.

Management of Complicated Crown Fracture: The main objective while treating such cases is successful pain management and immediate restoration of function, esthetics and phonetics. Conventionally, composite restorations and post and-core supported prosthesis are the most commonly used modalities. If the fractured tooth fragment is available, reattachment of the fragment is the most conservative option for restoration of such tooth.^[10]

Crown-root Fracture

It is a type of fracture that involves the enamel, dentin and cementum. Crown-root fractures extending apically towards both the gingival margin and the alveolar crest pose a great challenge.^[11] Most of these fractures occur as the result of a horizontal impact. If the force of the impact exceeds the shearing strength of the hard dental tissues, a fracture will occur which initially follow enamel rods of the labial surface of the crown and then takes an oblique course below the palatal gingival crest.

Treatment:

- Removal of the coronal fragment with subsequent restoration above gingival level.

- Removal of the coronal fragment supplemented by gingivectomy and osteotomy and subsequent restoration with a post-retained crown.
- Removal of the coronal fragment and surgical extrusion of the root.
- Removal of The coronal fragment and subsequent orthodontic extrusion of the root.

Luxation

Luxation injuries are one of the most prevalent traumatic dental injuries in the primary dentition. These injuries were first described by Andreasen. They involve a displaced tooth in the palatal/lingual or labial direction. The alveolar process is fractured due to the injury and as a result, the tooth becomes immobile. Lateral luxation injuries are one of the most common dental trauma injuries experienced. Lateral luxation make up 29.5% to 57% of all dental injuries.^[12]

Treatment consists of atraumatic repositioning and fixation which prevents excessive movement during the healing period. The value of antibiotic therapy is thus far unknown. Laterally luxated incisors should be repositioned with as little force as possible. This can be achieved either by digital pressure or surgically, with forceps, where after the tooth is repositioned apically. Digital pressure is presumably the gentlest.

Tooth Avulsion

Tooth avulsion is a complex traumatic injury characterized by the complete dislodgement of the tooth from its socket, which causes severe damage to the supporting tissues, vascular and nerve structures, requiring a prompt and correct emergency management for the good prognosis. It represents about 16% of all traumatic dentoalveolar injuries.^[13] Maxillary central incisors are the most affected teeth due to their labial projection which makes them more susceptible to facial trauma. Frontal impacts lead to avulsion with subsequent damage to both the pulp and periodontal ligament.

With respect to treatment of the avulsed tooth, storage conditions and the length of the storage period are of utmost importance for successful healing. Storage media most commonly used are

physiologic saline, blood, tissue culture media, milk and saliva.

A feature common to all of these media is their relative osmotic balance with pulp and periodontal tissues. Once the root surface and alveolus have been flushed with saline, the tooth can be replanted. This is accomplished using a minimum of pressure, being careful not to further damage the periodontal ligament and pulp. After repositioning of the tooth, a slightly flexible splint should be applied, such as an acid-etch retained splint of temporary crown and bridge material. Splint should be removed after 7 days to allow some functional movement of the replant in order to reduce or eliminate the risk of ankylosis.

INTER-APPOINTMENT EMERGENCIES

Hot tooth

A tooth that is difficult to anesthetize is known as a hot tooth. This is most commonly encountered in a mandibular first molar tooth where in after anesthetic block, the patient may describe profound numbness of the ipsilateral lip and tongue but still may experience acute pain during the access opening procedure.

Mechanism: There is a special class of sodium channels on C-fibers, known as tetrodotoxin-resistant (TTXr) sodium channels. These sodium channels are relatively resistant to lidocaine. Hot tooth may be explained by the fact that the TTXr sodium channels have not been adequately blocked by the anesthetic.^[6]

Treatment: Bupivacaine has been found to be more potent than lidocaine in blocking TTXr channels and may be anesthetic of choice when treating hot tooth. Supplemental intra ligamentary or intra osseous injection is most helpful to ensure profound local anesthesia.

Endodontic Flare-Ups

The inter-appointment flare-up is a true complication characterized by the development of pain, swelling or both, which commences within a few hours or days after root canal procedures and is of sufficient severity to require an unscheduled visit for emergency treatment. Studies have reported varying frequencies of flare-ups, ranging from 1.4 to 16%.^[14]

Special circumstances in which microorganisms can cause flare-ups are apical extrusion of debris, change in endodontic microbiota, secondary intra radicular infection and increase of the oxidation - reduction potential,

Preventive measures to infectious flare-up:

- Selection of instrumentation techniques that extrude less amounts of debris apically.
- Completion of the chemo-mechanical procedures in a single visit.
- Use of antimicrobial intracanal medicament between appointments in the treatment of infected root canals.
- Not leaving the tooth open for drainage.
- Maintaining the aseptic protocol during intracanal procedures.

Sodium Hypochlorite Accident

Several complications have been described in the literature during root canal irrigation with NaOCl inadvertently penetrating through the apical foramen or allergic reactions to the irrigant. Any irrigant, regardless of toxicity, has the potential to cause problems if extruded into periradicular tissues.

The main line of treatment is supportive including control of swelling, pain relief and prevention of secondary infection.^[15]

Perforation

Root perforation is an artificial communication between root canal system and the supporting tissues of teeth or the oral cavity.^[16] Iatrogenic perforation is a result of misaligned use of rotary burs during endodontic access preparation and search for root canal orifices.

Treatment:

The repair of the root perforations must be done immediately on occurrence to reduce the possibility of infection at the perforation site. Perforation defects have been repaired both surgically and nonsurgically using different materials such as zinc oxide eugenol, cavit, calcium hydroxide, glass ionomer cement, amalgam, gutta percha, tricalcium phosphate, hydroxyapatite, cold ceramic, mineral trioxide aggregate.

Iatrogenic Inferior Alveolar Nerve Injuries

Iatrogenic injuries to the third division of the trigeminal nerve remain a common and complex clinical problem. Injuries to inferior alveolar and lingual nerves are caused by local analgesia block injections and have an estimated injury incidence of between 1:26,762 to 1/800,000. Recovery is reported to take place at 8 weeks for 85–94% of cases.

Cervico-Facial Subcutaneous Emphysema

Subcutaneous emphysema is defined as the penetration of air or other gases beneath the skin and submucosa, resulting in soft tissue distention. Specific type cervico-facial subcutaneous emphysema is a relatively rare occurrence and may be limited to traumatic, iatrogenic or spontaneous events.^[17]

Treatment: Root canal treatment induced emphysema resolves in few days, administration of prophylactic antibiotics and analgesics can prevent complications because dissemination of oral flora microorganisms along the emphysematous tracts may be responsible for soft tissue infections (e.g. deep neck infection and mediastinitis) and sepsis.

POST-OBTURATION EMERGENCIES

After the completion of root canal treatment, patients usually complain of pain, especially on biting or chewing. More postoperative pain is encountered in endodontic treatment of posterior teeth. There are more chances of experiencing postoperative discomfort when pain is present preoperatively. Postoperative pain after RCT has been reported from 1.9% to 48%.^[18] It may persist from few hours to many days after endodontic therapy.

Factors responsible for post obturation pain:

- Overextended filling
- Under filling
- Fracture of root
- High restoration
- Poor coronal seal.

Vertical Root Fracture

According to the American Association of Endodontists, “A vertical root fracture is a

longitudinally oriented fracture of the root that originates from the apex and propagates to the coronal part.”^[19] According to the literature, vertical root fracture is the third most common reason for extraction of an endodontically treated tooth. Vertical root fracture is an important threat to the tooth's prognosis during and after root canal treatment.

Treatment: In single rooted teeth, extraction of the tooth is recommended. In multi-rooted teeth uniting the fragments and replanting the tooth in its socket.^[20] Materials like GIC, dual cure resin cements, fiber posts with composite resins have been used to unite the fractured fragments.

CONCLUSION

Absolute attention to the patient's chief complaint, properly gathering the clinical data and rendering the appropriate treatment to remove the causative etiology will ensure proper management of endodontic emergencies. The main reason for endodontic emergency treatment is pain and at times swelling resulting from pulpo-periodontal pathosis. The aim of emergency endodontic treatment is to relieve pain and control any inflammation or infection that may be present. Endodontic emergency treatment usually upsets the dental practitioners, because time must be taken from another scheduled appointment to dispense the needed relief. The key to the successful management of dental pain is to judiciously establish a diagnosis and treat the condition efficiently and effectively.

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