

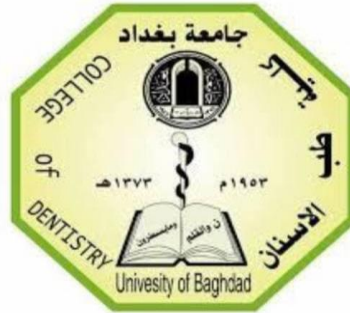
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Ministry of higher education

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Endodontic flare-ups

A Project Submitted to:

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Department of Conservative Dentistry in Partial Fulfillment of the
Requirements for the B.D.S. Degree

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Certification of the Supervisor

I certify that this project entitled "Endodontic flare-ups" was prepared by the fifth-year student "Faidh Ahmed Abdulatif " under my supervision at the University of Baghdad, College of Dentistry in partial fulfillment of the graduation requirements for the Bachelor Degree in Oral Surgery.

Dedication

I want to dedicate this review to my beloved father who I wish He was
here

to my beautiful mother who gave me all love, support and
encouragement in the world. I can't describe how grateful I am for
having her

To my beloved brother who always support me and gave me love and
encouragement whenever he was

Without them I would never make It to this point

To my beautiful friends (Asraa,Aya,Alaa,Fatima,noor,Maryam,Fatima
and Rania) for always being there for me and for making my days at
college a beautiful and memorable journey

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1.Introduction

Endodontic treatment can stimulate potential symptoms such as pain and swelling during or after the treatment, known as the Endodontic flare-ups, which is a nightmare for both Dentist and Patients. Its incidence can vary from 1.4% to 50%. The multi-causal origin of these flare-ups include the microbial factors, the patient factors and the treatment factors. Among these, conceivably, micro-organisms play a major role. The principal reason for the inter-appointment pain is the development of acute inflammation in the peri-radicular tissue region in response to any irritation extending from the root canal system. Considering these situations, preventive measures and treatment strategies against these flare –ups has been proposed. Having a proficient knowledge about the etiologic factors and the management of these flare –ups can help in reducing the occurrence of this abominable event

An inter-appointment flare-up is characterized by the development of pain, swelling or both, which commences within few hours or days after the initiation or even completion of root canal treatment, which requires an unscheduled visit and active treatment. It is an undesirable event to both the clinician and the patient.

An endodontic flare up is defined as an acute exacerbation of an asymptomatic pulpal and /or periradicular pathoses, after initiation or continuation of root canal treatment (**American Association of Endodontists; 2003**)

Interappointment pain is almost exclusively due to the development of acute inflammation at the peri radicular tissues in response to an increase in the intensity of injury coming from the root canal system (**Siqueira and Barnett 2004**). The patient experiences varying degrees of pain, which is residual or even exaggerated

during and following endodontic treatment (**Priyanka and Veronica 2013.**) It is of much concern when the patient was previously asymptomatic. Fortunately, the occurrence of flare-ups has no effect on the prognosis of the treatment.

The patients may underestimate the clinician's skills and such an episode also, undermine the patient's confidence in their dentists or patient satisfaction with the treatment (**Van Wijk and Hoogstraten 2006**). Hence it is desirable to know about the various reasons for an endodontic flare up and also prevent and manage this complication

2.Incidence

The incidence of endodontic flare-ups varies according to various studies. It varies from 1.4% to 1.6% (**Alves 2010**) and up to 50% (**Alves 2010**) in some researches. The occurrence of flare-ups depends on the preoperative pulpal and periapical diagnosis, the presence of pre-operative pain and swelling, medications taken, type of instrumentation technique and the number of visits taken to complete a root canal treatment. Its incidence has a direct relationship with the patient's preoperative pathogenesis and signs/symptoms. Lowest frequency is found in patients with vital pulp without periapical pathogenesis and highest frequency among the patients with necrotic pulp and acute apical periodontitis (**Walton 2002**)

In a study conducted by Pamboo J et. al in 2014 the following inferences were observed. This study showed a low incidence of flare-ups of 2.35%. Age has no influence on the occurrence of flareups. Women experienced more pain compared to men and also had low pain threshold levels. Endodontic flare-ups are more prevalent in females under age of 20 years usually in maxillary lateral incisors, mandibular molars with large periapical lesion and retreatment of previous root canal treatment (**Lakshmi et al 2020**)

Posterior teeth in the mandibular arch experienced more pain because of the presence of a greater number of canals and bifurcated root canals. The pre-operative pain has a direct influence on the incidence of flare-ups. The incidence of flare ups is more with a necrotic pulp than a vital pulp. Most of the post-operative pain can be controlled by the usage of anti-inflammatory drugs and the judicious use of antibiotics.

There was no difference in the incidence of flare ups between single and multiple visits. Most of the studies have found that single visit treatment resulted in less pain compared to multiple visits. The crown down technique with rotary action combined with copious and frequent irrigation resulted in decreased incidence of flare-ups. Intra canal medication is a preventive measure to reduce the incidence of flare-ups (**Pamboo et al 2014**)

3. Causes of endodontic flare ups

3.1. Mechanical factors

Mechanical factors, during the endodontic treatment, could be associated with flare up mechanism, since during this stage, a number of debris, necrotic pulp masses, irrigative solutions and microorganisms can be pushed from the root canal to the apical periodontal tissues, leading to inflammation and pain that disturbs healing of periradicular tissues (**Tinaz et al., 2005**).

Previous studies showed that, a combination of crown-down technique with engine-driven nickel titanium Ni-Ti systems will lead to a minimal extrusion of debris (**Siqueira, 2003**).

Reddy and Hicks showed that cleaning canals with Manuel instruments using step-back technique leads to a higher amount of extrusion of debris (2.58 mg) into the periradicular tissues than NiTi rotational mechanical instruments (0.5 mg) with crown-down technique (**Pasqualini et al., 2012**). These results are consistent with other studies showing that rotary instruments application during endodontic treatment leads to a lower incidence of flare up compared to Manuel instruments (**Kashefinejad et al., 2016**).

Recently, with the introduction of the reciprocating instruments into the endodontic market, many studies compared them with rotary instruments, regarding their association with the flare up issue. Remarkably, reciprocating instruments showed a higher incidence of post-operative pain than Rotary instrument **(Eyuboglu and Ozcan, 2019)**.

However, Garcia et al. showed that endodontic retreatment with Reciprocating instruments resulted in lower values of postoperative pain compared to Profile **(Garcia-Font et al., 2018)**.

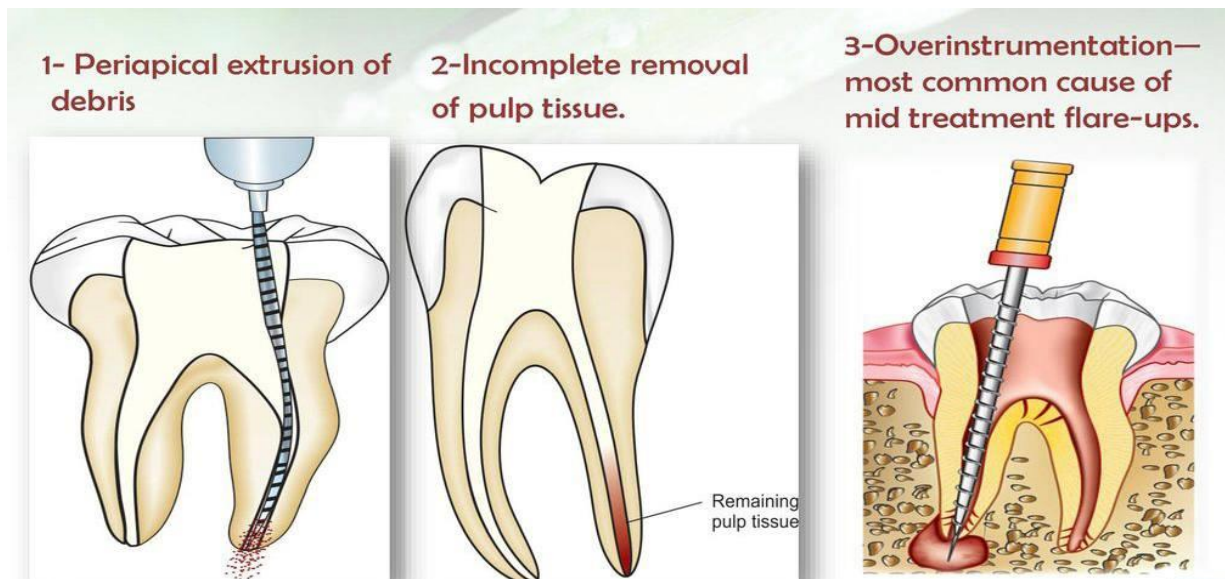


Figure (1) mechanical causes of flare-ups

3.2. Chemical factors

Substances used in endodontic treatment (such as: intracanal medicaments, irrigation solutions and sealer) might be toxic, causing irritation and flare up if they reached the periradicular tissues. The inflammatory response intensity is proportional to the number of substances extruded **(Hawker et al., 2011)**.

It has been shown that flare ups are often related to the use of resorcinol formaldehyde resin in the obturation in endodontic retreatment. Moreover, formaldehyde is considered cytotoxic, causing necrosis of living tissue and if extruded in the periradicular area will lead to pain and swelling (**Moline, 2006**). The type of solution used for irrigation during treatment has no influence on the incidence of flare-ups (**Onay et al., 2015**). However, in 2010, one study showed that the use of 5.25% sodium hypochlorite for irrigation was related to higher incidence of pain when compared to the use of 2% chlorhexidine solution (**Bashetty and Hegde, 2010**). Lately, Riaz et al. compared the same solutions with the same concentrations and observed no difference concerning postoperative pain (**Riaz et al., 2018**).

In 2012, Fedorowicz et al., compared different solutions of irrigation (5.25% NaOCl, 5.25% NaOCl combined with 3% hydrogen peroxide and 5% of NaOCl used alone or in combination with proteolytic enzyme) and showed that postoperative pain after root canal treatment is not influenced by irrigant solutions (**Fedorowicz et al., 2012**). Another study showed that 5.25% NaOCl was associated with significantly lower postoperative pain compared to 2.5% NaOCl (**Farzaneh et al., 2018**). Recently, in 2020, 1.3% NaOCl has been shown to be associated with less intense and less frequent post-endodontic pain when compared to 5.25% NaOCl. These results, didn't match with those found by Verma et al. when they compared 2 different concentrations of sodium hypochlorite (1% and 5%) and did not find a significant difference in the clinical outcome concerning postoperative pain (**Verma et al., 2019**).

3.3. Microbial causes

Generally, there is balance between the bacterial aggression and the host defense mechanisms. In some situations, during endodontic treatment this balance is disrupted, which Favours the microbial aggression causing an acute peri radicular inflammation. These situations could be when there is an apical extrusion of infected debris, changes in the root canal microflora and environmental conditions caused by incomplete chemo-mechanical preparation, secondary intraarticular infections and an increase in the oxidation- reduction potential within the root canal, all of which favors the growth of facultative bacteria.

Specific pathogenic strains, virulent clonal types, the number of cells and microbial interactions are the factors which influence the development of pain associated with endodontic infections (**Siqueira 2003**)

It has been suggested in some reports that the presence of certain bacterial species is associated more with particular peri-radicular diseases. Symptomatic peri-radicular lesions including teeth with abscess are associated more with Prohormones species (**Sundqvist 1985**).

Acute clinical symptoms are associated with Prevotella and Pepto streptococcus species (**Yoshida et al 1987**). Percussion pain frequently exhibited Peptostreptococcus, Eubacterium, Porphyromonasendodontalis, P.gingivalis and Prevotella species (**Hashioka et al 1992**). All these reports are suggestive that Gram- negative anaerobic bacteria are closely associated with the occurrence of symptomatic endodontic infections including acute abscess

3.3.1 Apical extrusion of debris

The apical extrusion of infected debris into the peri-radicular tissues is one of the principal causes of post-operative pain (Seltzer and Naidorf 1985) In asymptomatic cases, there is a balance between the bacterial aggression and the host defense. During the chemo-mechanical preparation, when the infected debris is extruded, this balance is disrupted, for which the host mobilizes an acute inflammation in order to re-establish the equilibrium (Siqueira 2003).



Figure (2) apical extrusion of debris

instrumentation promotes the apical foramen enlargement, which permits the influx of exudates and blood into the root canal, enhancing the nutrient supply to the remaining bacteria within the root canal, which proliferates causing an acute exacerbation of a chronic peri-apical lesion (Chavez de Paz 2002) Crown down technique with rotary motion and frequent irrigation usually extrude less infected debris into the periapical area.

3.3.2 Changes in the endodontic microflora and / or environmental conditions

Normally the root canal bacteria exist in harmony and equilibrium with their environment. Endodontic procedures cause a change in the root canal environment. When the microorganisms are not completely eliminated from the root canal, environmental changes occur, causing the previously inhibited species to overgrow and turn virulent. This damages the peri-radicular tissues leading to an acute exacerbation. When the environmental changes cause a turn on of the virulent genes, previously asymptomatic tooth turns symptomatic. When environmental changes induce a turn-off of the virulent genes, remission of symptoms of the previously symptomatic cases could occur

. In order to avoid this, a complete chemo-mechanical preparation should be completed within the same visit whenever possible and intra canal medicament should be placed in cases of multiple visit procedure (Siqueira 2003)

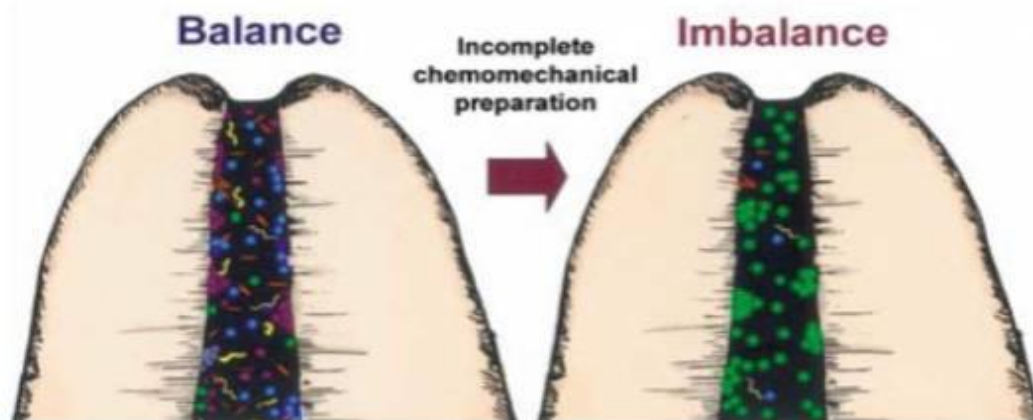


Figure (3) Changes in the endodontic microflora

3.3.3 Secondary intra-radicular infection

They are caused by microorganisms which were not present in the primary infection. They penetrate the root canal during the treatment, between the appointments or after the completion of the endodontic treatment. The main source of recontamination could be the remnant plaque, calculus or caries; leakage from rubber dam; contamination of endodontic instruments or irrigating solutions (Siqueira 2002) leakage through breakdown of temporary restoration; fracture of tooth (Siqueira et al 2000) and when the tooth is left open for drainage (Siqueira et al 1998a). Regardless of the time of introduction of microbes, a secondary infection can cause a flare-up, if the microbes are virulent and they multiply to reach a sufficient number to cause an acute inflammation of the peri-apical tissues

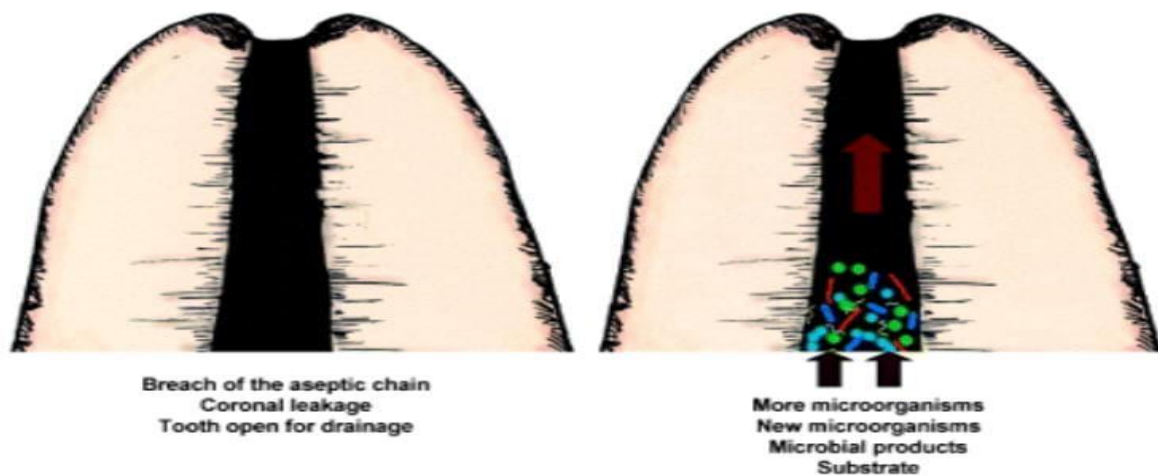


Figure (4) Secondary intra-radicular infection

3.3.4 Increase in oxidation-reduction potential

When the tooth is opened, the oxygen penetrates the root canal, changing the microbial growth pattern from anaerobic to aerobic. The energy yield is more marked in the presence of oxygen, and there is a faster growth rate causing an acute peri-apical inflammation (Matusow 1995)

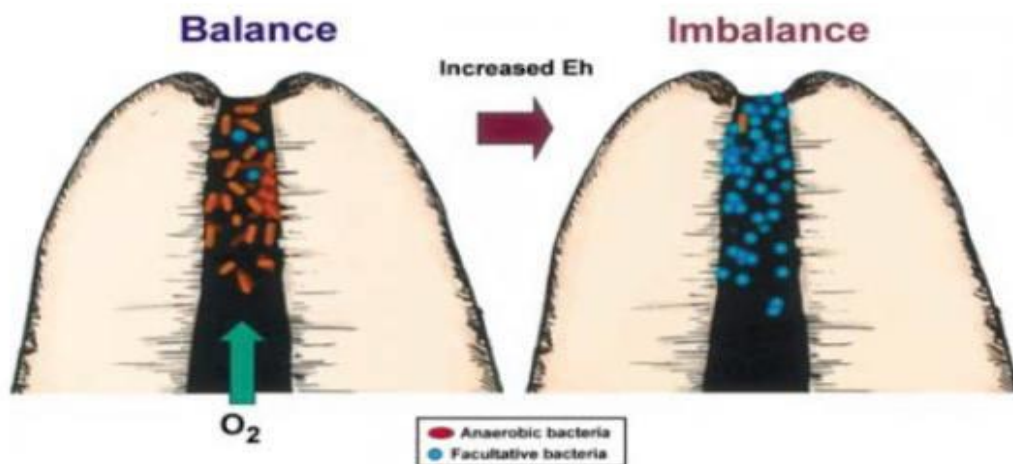


Figure (5) Increase in oxidation-reduction potential

4. Hypothesis for flare ups

There are a number of hypotheses thought to be related to the etiology of flareups

4.1 - Alteration of local adaptation syndrome

Local tissue adaptation has been shown experimentally by (Selye 1953) when a new irritant is introduced in a chronically inflamed tissue, a violent reaction may occur because of disturbance in local tissue adaptation to applied irritants. For example, in case of chronic pulpal diseases, the inflammatory lesion is adapted to irritants but during root canal therapy, a new irritant in form of

medicament gets introduced in the lesion leading to flare-up

4.2 Changes in Periapical Tissue Pressure

The experiments of **Mohorn et al 1971** Studies have shown that endodontic therapy causes pressure changes in periapical area in both directions Teeth with POSITIVE periapical pressure, excessive exudate creates pain by causing pressure on nerve endings. Root canals of such teeth when kept open, exudate comes out but in teeth with NEGATIVE periapical pressure, microorganisms and altered tissue proteins gets aspirated into periapical area leading to increased inflammatory response and pain .

4.3 Microbial Factors:

Gram-negative Anaerobes Produce a variety of enzymes and release neurotoxic endotoxins. Also, they activate the Hageman factor to release bradykinin, a potent pain mediator. Teichoic acid, present in the cell wall and plasma membranes of many gram-positive bacteria is potent immunogen, producing humoral antibodies IgM, IgG, IgA and releases various chemical mediators that cause pain.

4.4-Effects of chemical mediators

Cell mediators Like histamine, serotonin, prostaglandins, platelet activating factors, leukotrienes etc. are capable of producing severe pain, which are released from cells.

4.5 -Changes in Cyclic Nucleotides

Increased levels of cAMP inhibit mast cell degranulation which helps in reducing pain whereas increase in cGMP levels stimulate mast cell degranulation which results in increase in pain. Studies have shown that during flare-up, there is increased level of cGMP overcAMP concentrations.

4.6- Immunological Response

In chronic pulpitis and periapical disease, presence of macrophages and lymphocytes indicates both cell mediated and humoral response. Despite of their protective effect, the immunologic response also contributes to destructive phase of reaction which can occur, causing perpetuation and aggravation of inflammatory process.

4.7-psychological factor

Anxiety, fear, psychosis, apprehension & previous traumatic dental experience means a lot to dental patients especially during root canal procedures These anxieties aggravate and intensify painful episodes

5. PATIENT PRESENTING FACTORS

5.1 Patient demographics

The correlation between incidence of flare ups and some demographic criteria like age and gender are still controversial. While different reports showed absence of correlation between the incidence of flare ups and age and gender of the patient (**Walton, 2002**)(**Onay et al., 2015**), a report from El Mubarak et al. (2010) showed that post-operative pain often occurs among patients with age ranging between 18 and 33 years old (**Naoum and Chandler, 2002**). Moreover,(**Azim et al. (2017)** stated that age is a strong predictor for flare ups, especially in patients older than 50 years (**Azim et al., 2017**). This result correlates with the one obtained by **Nair et al.(2017)** showing that patients in the age group of 40–60 years had a higher risk of developing flare-ups (**Nair et al., 2017**).

Concerning the gender factor, while some studies showed that women are more susceptible to develop flare ups than men (**Naoum and Chandler, 2002**), other reports showed no correlation between gender and pain after endodontic treatment (Glennon 2004)

5.2 Pulp and periapical status

some studies showed that necrotic pulp is positively correlated with postoperative pain (**Walton, 2002**) (**Siqueira, 2003**) (**Tinaz et al., 2005**) (**Gotler et al 2012**) (**Azim et al., 2017**). This could be explained by the fact that microorganisms are essential for inflammation induction in the periradicular tissue, so it is logical that treatment of necrotic tooth will be related to a higher level of flare ups than in the case of vital tooth. However, different studies showed that a

higher incidence of flare ups is related to vital tooth (**Gotler et al., 2012**). Patient signs and symptoms Patient with preoperative swelling or pain is likely to develop interappointment flare-up. It is likely that patient with pain is associated with increased stress levels; this may adversely have its impact on the immune functions.

5.3 Treated tooth

Endodontically treated-Mandibular molar are related to a high incidence of post operative pain (**Segura-Egea et al., 2009**) (**Ali et al., 2016**) (**Shresha et al., 2018**). This can be attributed to the fact that the mandibular arch has a cortically thicker plate compared to maxilla, especially at the level of molars. This, in turn, results in the accumulation of exudates in addition to a lower blood circulation, that will lead to a delayed healing. On the contrary, other reports showed no significant association between the tooth type and the incidence of flare ups after endodontic treatment (**Onay et al., 2015**).

5.4 Number of visits during the treatment

In endodontic treatment, the tooth status is considered as the main determinant if the treatment will be accomplished in one or more visits. When the tooth is vital or retreated with no clinical symptoms, one visit is recommended (**Figini et al., 2008**). In the case of a necrotic tooth with radiological changes in the peri radicular area, two visits are recommended with the use of an interappointment intracanal medicament, for a maximal disinfection (**Figini et al., 2008**). However, in the last decades, a single visit of treatment was the most recommended (**Qualtrough et al., 1999**). This is feasible due to the huge advances in the endodontic field, such as NiTi rotary instruments, reciprocating instruments,

apex locaters, digital radiography, biocompatible sealer, microscopic endodontics and developed irrigation technique (**Kishen et al., 2016**).

While some studies showed no correlation between incidence of flare-ups and number of visits (**Figini et al., 2008**) (**Ince et al., 2009**) (**Ali et al., 2012**) (**Nair et al., 2017**) (**Sevekar and Gowda, 2017**) (**Riaz et al., 2018**), others revealed the preference of a single treatment visit for a better outcome concerning flare-ups (**Mohammadi et al., 2006**) (**Onay et al., 2015**). Oppositely, different studies showed that flare-ups are more common for single visit root canal treatment. These controversial results could be attributed to many factors including the sample size, endodontic technique used and tooth status

5.5 Intracanal medicaments

Antimicrobial intracanal medication with a well-done endodontic treatment leads to a better outcome and less postoperative pain (**Ehrmann et al., 2003**) (**Singh et al., 2013**). However, some studies showed no correlation between the use of the intracanal medication and the occurrence of postoperative flare-ups (**Siqueira, 2003**). Despite its effectiveness against microorganisms (**Georgopoulou et al., 1993**), calcium hydroxide Ca (OH)₂ effect was found to be limited on postoperative pain (**Anjaneyulu and Nivedhitha, 2014**)(**Singh et al. 2013**) demonstrated that usage of chlorhexidine with or without Ca (OH)₂ reduces postoperative pain (**Singh et al., 2013**). In 2017, Sinhal et al. showed that 2% chlorhexidine gel and triple antibiotic paste reduce the interappointment flare-up and postoperative symptoms in diabetic patients, when compared to calcium hydroxide paste (**Sinhal et al., 2017**). These results are in agreement with those obtained by Swathi et al.

in 2014, where Triple antibiotic paste was found to be more effective than calcium hydroxide in preventing the occurrence of flare-up (**Pai et al., 2014**). On the other hand, Ledermix is more effective in reducing postoperative pain when compared to Ca (OH)₂ (**Ehrmann et al., 2003**).

6. Treatment plan

Factors related to the treatment plan include whether single or multiple visits are employed, conventional or retreatment procedures and whether partial or complete debridement is done. The goal is to minimize the post-operative pain whether it is done in a single or multiple visits. Some studies reveal it is better to complete the procedure in a single visit to minimize the postoperative pain. Obturation done in the same visit minimizes the incidence of flare-ups (**Walton and Fouad A. 1992**). However, in cases of pulpal necrosis with apical periodontitis the incidence of flare ups is more, so multiple visits can be employed. The main goal of the endodontic treatment is to completely debride and disinfect the root canals to get rid of the microbes that cause persistent infection. Inadequate debridement could lead to acute exacerbation. Intra canal placement of steroids or NSAID's could reduce the postoperative pain (**Walton 2002**)

Other factors that have an influence on the incidence of flareups include over-instrumentation, incorrectly measured working length, periapical extrusion of infected debris, extruded irritants, overfilling and hyper occlusion (**Torabi Nejad et al 1988**) Inadvertent extrusion of irrigants beyond the apical foramen will lead to violent reactions – pain, swelling, hematoma, burning sensation, ulceration, tissue necrosis. Also, excessive pressure during irrigation will cause large amounts of irrigant to come in contact with the periapical tissues. Occlusal reduction as a

prophylactic procedure is ineffective, but for teeth with pain on mastication, occlusal reduction reduces the post-operative pain

6.1 Localized treatment measures

These measures include re-instrumentation, relief of occlusion, placement of intra canal medicament and establishment of drainage

6.1.1 Re-instrumentation

When the working length is short of the apex, it leads to incomplete debridement leaving remnant necrotic pulp tissues uncleaned in the apex which may lead to the development of flare-ups. If the working length is too far beyond the apex, there is extrusion of the infected debris, irrigants and medicaments peri apically causing an inflammatory response. Once the patient reports with a flare-up, correct working length is established, followed by complete debridement carefully with frequent and copious irrigation, placement of an intra canal medicament and a temporary restoration (**Kaur.2015**) Radiographs should be taken at different angles to rule out the incidence of any missed canals (**Garg and Garg A 2010**)

6.1.2 Relief of occlusion

When an acute abscess develops post-operatively, the tooth gets extruded from the socket, resulting in tenderness on percussion and difficulty in biting. Such teeth should be relieved of occlusion judiciously especially the functional cusps. However, some authors suggest a prophylactic occlusal reduction in cases reporting with apical periodontitis (**Rosenberg et al1998**)

6.1.3 Establishment of drainage

Suppuration usually results in the presence of infections. In such a scenario, drainage of the exudate is the most effective method of reducing the pain and swelling. This is established by removing the temporary dressing from the root canal and the temporary filling of the access opening. In most cases, the accumulated exudates surge through the root canal. In some instances, when there is a blockage of the debris apically, drainage is difficult. In such instances an endodontic instrument is passed through the root canal to re-establish the patency. In exceptional cases, when this also does not provide relief, surgical intervention is necessary. A soft tissue incision or removal of the alveolar bone over the tooth apex to create an artificial sinus tract provides relief.

Following the drainage, when the exudation has reduced, a temporary closed dressing can be given. However, some authors prefer to leave the canal open for drainage till the next visit. But this exposes the tooth to the oral microflora and the salivary products leading to an increase in the bacterial growth, introduces new microorganisms into the root canal thereby activating the complement system, leading to an acute exacerbation (**Seltzer et al 2004**), (**Kaur 2015**)

6.2 Intra-canal medicaments

Medicaments that have been claimed to provide relief during the acute exacerbation include anti-microbial agents, irrigating solutions, sulfa compounds and steroids

6.2.1 Irrigating solutions

The type of irrigating solution used has a very little difference in the incidence of post-operative discomfort, provided the irrigating solutions were not forced beyond the apex (**Seltzer et al 2004**) Harrison et. al found a higher incidence in post-operative pain in canals either not irrigated or irrigated with normal saline, compared with those irrigated with 5.25% sodium hypochlorite and 3% hydrogen peroxide (**Harrison et al 1983**)

6.2.2 Sulfa-compounds

Sulfa compounds when placed inside the root canals, have been reported to reduce the incidence of pain postoperatively. Some studies show that sulphonamides are no better than placebos (**Seltzer 1961**)

6.2.3 Corticosteroids

The anti-inflammatory property of corticosteroids is its ability to retard the release of lysosomes from the cells and inhibit the liberation of free arachidonic acid from phospholipids of the cell membrane by phospholipases. Steroids not only prevent the formation of prostaglandins and thromboxane but also leukotrienes and other oxygen derivatives. This hormone may cause a hyperpolarization of the nerves in the inflamed area leading to increase in cyclic AMP, which reduces the transmission of nerve impulses (**Goldstein 1976**), (**Kebabian 1971**) the disadvantage of the usage of steroids in endodontic therapy is that it interferes with phagocytosis and protein synthesis as a result of which the repair gets delayed (**Smith et al 1976**).

6.3 Psychological management

The patient presents with fear, anxiety, doubt and often the patient assumes that the treatment has failed and extraction is needed. Hence Reassurance is a critical aspect of treatment. The patient must be explained that flare-ups do occur and are treatable and such instances do not affect the outcome of the treatment. Since fear and anxiety are directly related to the perception, the pain can be successfully managed if there is a reduction in the level of fear and anxiety. The problem must be addressed to the patient and explained about the possible reasons for the pain and swelling. The most important step is to break the pain cycle (**Kaur 2015**), (**Walton 2002**)

6.4 Pharmacotherapeutics

6.4.1 Local anesthetics

Sensory nerve blockade is difficult with analgesics, thus demanding the use of long-acting local anesthetics (**Dunsky and Moore 1984**). Breaking the pain cycle is important psychologically and neurophysiologically (**Dunsky and Moore 1984**)

6.4.2 Antibiotics

Antibiotics are widely used in endodontics, but their use is debatable in patients with pain and swelling. The systemic use of antibiotics should be restricted and prescribed only when there are systemic manifestations like cellulitis, fever, malaise and toxemia (**Kaur 2015**), (**Seltzer et al 2004**)

Antibiotics are effective when the cause of flare-ups is microbial. Penicillin is used for most of the dental infections. Because of the poly- microbial cause of

dental infections, antibiotics to treat the anaerobic infections are also commonly prescribed (**Seltzer et al 2004**)

6.4.3 Analgesics

Mild to moderate cases are treated with NSAID's and severe cases or which are unresponsive to NSAID's are treated with opioids and steroids (**Kaur P 2015**). NSAID's have analgesic with little or no anti-inflammatory properties. Their analgesic and anti-inflammatory property is due to the inhibition of prostaglandin synthesis by cyclo-oxygenase enzyme (**Priyanka and Veronica 2013**) They also inhibit phosphodiesterase, leading to increased cyclic AMP production (**Weiss and Haitt 1977**). Narcotic analgesics react with the neurons in the brainstem, spinal cord, thalamus and cerebral cortex. Sharp, localized pain are poorly relieved by opiates, whereas they relieve dull, chronic and less severe pain (**Miller 1976**) However they are capable of increasing the pain threshold by causing relaxation and freedom from anxiety (**Schuster 1976**)

Systemic corticosteroids have been successfully used to reduce the pain and swelling of dental origin (**Messer and Keller 1976**), (**Williamson et al 1980**) The incidence of post-op pain was less when steroids were administered pre-operatively.

7. Treatment of flare-ups in different clinical situations

7.1 Previously Vital Pulps (with or without complete debridement)

A previously vital pulp will develop into an acute apical abscess. This will occur sometime after the appointment and indicates that pulpal remnants have become necrotic and are invaded by bacteria. It is also likely that tissue remnants have become inflamed and are now a major irritant. The working length should be rechecked, and the canal(s) should be carefully cleaned with copious irrigation of sodium hypochlorite they should be opened and debrided, medicated with calcium hydroxide paste, and closed. If not, these cases are managed with incision and drainage **(Richard and Walton 2002)**

7.2 Previously Necrotic Pulps with No Swelling

In these cases, occasionally acute apical abscess may develop which is confined to the bone and can be very painful. The tooth has to be opened, gently recleaned, irrigated with sodium hypochlorite and drainage should be established **(Richard and Walton 2002)**

7.3 Previously Necrotic Pulps with Swelling This situation is unlikely to be a true flare-up, patient reassurance and prescription of analgesics will suffice. Nothing is gained by opening these teeth and pain will regress spontaneously **(Richard and Walton 2002)**

8. Prevention

Certain guidelines should be followed by the clinician to prevent the occurrence of flare-ups.

- Asepsis: is the key of success of any endodontic treatment, and dentists should ensure the accomplishment of the endodontic treatment in aseptic conditions, avoiding any contamination. The use of rubber dam during treatment is one of these conditions **(Siqueira, 2003)**
- Access cavities should never be left open during the inter-appointment period as there are chances for the development of secondary peri-radicular infections. Access cavities should never be dried with compressed air as there are chances for extrusion of debris. To avoid this cotton pellets can be used for this purpose.
- The use of preoperative medicines such as: Ibuprofen, dexamethasone, diclofenac sodium, piroxicam, deflazacort, ketorolac or prednisolone, especially in cases with symptomatic irreversible pulpitis **(Praveen et al., 2017) (Veitzand Ferraiolo, 2018) (Konagala et al., 2019)(Aksoy and Ege, 2020)**
- Adopting a chemico-mechanical procedure producing the less amount of debris extrusion in the peri radicular area, and ensuring the debridement of the totality of the root canal system. On example is the combination of crown-down technique with engine-driven Ni-Ti Systems and an appropriate irrigation **(Siqueira, 2003)**. The use of apex locator and radiology is essential

for precisising the working length WL. Some devices could be used to enhance the irrigation efficacy.

- Cases reporting with pain on percussion in the first visit should be relieved occlusally.
- Accomplishment of the endodontic treatment during one visit if possible, and use of intracanal medications between sessions for infected teeth **(Ehrmann et al., 2003) (Singh et al., 2013)**. In addition, prescription of postoperative medicine is efficient in controlling pain, like Corticosteroids, NSAIDs or paracetamol **(Shamszadeh et al.,2018)(Suneelkumar et al., 2018) (Stamos et al., 2019)**

9. Conclusion

Though the occurrence of endodontic flare-ups does not affect the treatment outcome, it is undesirable to both the patient and the clinician. So, it is the responsibility of the clinician to follow proper guidelines and employ proper measures to prevent its occurrence and be able to treat it effectively if it occurs. Having knowledge of its etiopathogenesis, contributing factors and treatment modalities will help to manage the situation effectively.

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