Republic of Iraq

Ministry of Higher Education and Scientific Research

University of Mosul

College of Dentistry.

ROOT CANAL PERFORATION

A Project Submitted to

The College of Dentistry , University of Mosul , Department of Conservative Deentistry in Partial Fulfillment for the Bachelor of Dental Surgery.

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2024-2025

Certification of the Supervisor

I certify that this project entitled " **Root Canal Perforation**" was prepared by the fifth-year student " **Rana Khalid Elias** " under my supervision at the College of Dentistry / University of Mosul in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor is name : **Assist.Lecturer: Amjad Loqman Shehab**

The Date: / /

Dedication

To those who instilled in me the love of knowledge and learning, to my dear parents, who supported and prayed for me in every step I took, to my brothers who shared with me moments of striving and diligence, to everyone who extended a helping hand to me, with a kind word or moral support, or sincere guidance, and to my teachers from whose knowledge I gained, and who were a light that illuminated the path of research and knowledge for me, to my esteemed teacher ,Assist. Lecturer: [**Amjad Luqman Shihab**], who was a help to me with his valuable guidance and vast knowledge, I have all appreciation and respect for him.

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Chapter One

1.Introduction

Perforation is an artificial opening between the root canal system and the surrounding tissues of teeth **(Senthilkumar and Subbarao, 2017)** ,This issue can be caused by a pathological process (dental caries, root resorption) cause connectivity between the root canal and periodontium or an operative procedural accident. Pathological perforations are found in routine clinical exams, whereas iatrogenic root perforations may occur during access cavity opening, root canal preparation or during post-preparation**(Estrela et al., 2018).** Root resorption and caries are the common causes for non-iatrogenic perforation. In approximately(2%–12% of) endodontically treated teeth, accidental root perforations may occur, which may have serious implications. An infectious process once started at the perforation site either from the root canal or from periodontal tissues impairs the healing and initiates an inflammatory process that exposes the supporting tissues to infection, pain and suppurations. **(Deepak et al., 2021).**

The important factors in determining the success of a perforation repair are the time interval between the occurrence of a perforation and its repair, the size of the perforation and its location. The location of the perforation in relation to the level of the epithelial attachment and crestal bone is probably the most important factor in terms of prognosis .The closer the perforation to this critical zone, the poorer the prognosis, due to susceptibility of the site of perforation to contamination from microorganisms. Moreover, if the perforation is not closed immediately,

apical migration of the epithelial attachment may occur, resulting in a periodontal defect .

2.Aims of the study:

1.Classify the types of root canal perforation &identify its causes.

2.Review the materials used in treating root canal perforation.

3.Illustrate how to avoid & manage the root canal perforation &how to treat it effectively.

Chapter Two

1.Review of Literature

Perforations that occur during endodontic procedures represent a significant factor contributing to the failure of these treatments. Such perforations may arise from various causes, including root resorption , the trajectory of caries development, or iatrogenic factors during procedures like post cavity preparation. The classification of root perforations is important in dentistry as it helps in diagnosing the extent of the perforation and determining the appropriate treatment. Perforations can be classified based on their location, size, and the cause of the perforation. Understanding these classifications allows dental professionals to develop effective strategies for managing and repairing perforations, ultimately aiming to preserve the tooth and maintain oral health.

2.Classifications:-

Based on factors impacting the outcome of treatment, fuss and trope 1996 classified perforation as follows:

2.1 Based on time:-

A. Fresh perforation:-

Fresh perforation occurs during operative or endodontic procedure characterized by fresh blood at the site of perforation. If treated immediately, it has a good prognosis.

B. Old perforation:-

The untreated perforation acts as a source of infection either from periodontium or by secondary caries An old root perforation refers to a perforation that has occurred some time ago, allowing tissue healing or changes to develop around the affected area. It may involve scar tissue formation, chronic infection, abscesses, and changes in root shape. Often, there are no clear symptoms, but mild discomfort or swelling may persist. Over time, the tooth's function may deteriorate, and the perforation may become harder to treat due to surrounding tissue changes. **(Senthilkumar and Subbarao, 2017).**

2.2 Based on size:

A. Small perforation:-

These are smaller than size(#20) endodontic instrument and have a good prognosis.

B. Large perforation:-

It occurs during post-space preparation, and due to salivary contamination and coronal leakage, these have a questionable prognosis. **(Senthilkumar and Subbarao,(2017).**

2.3 Based on location:

A. Coronal perforation:-

These are perforations that occur coronal to crestal bone and epithelial attachment and have a good prognosis.

B. Crestal perforation:-

These occur at the level of epithelial attachment into the crestal bone, and these have a questionable prognosis.

C. Apical perforation:-

These occur apical to the crestal bone and epithelial attachment and have a good prognosis as there is less risk of salivary contamination. **(Senthilkumar and Subbarao, 2017).**

Fig.(1): Perforations caused by procedural error, caries, or a resorption process. Left: Radiograph showing a crestal perforation, due to a misaligned post placement Middle: Radiograph showing deep caries resulting in perforation Right: Radiograph showing cervical invasive resorption resulting in perforation**.(Baumann and Beer, 2010).**

3.Aetiology:

The etiology of root perforation refers to the various causes that lead to the development of perforations in the roots of teeth as follows:

3.1 Iatrogenic perforation:-

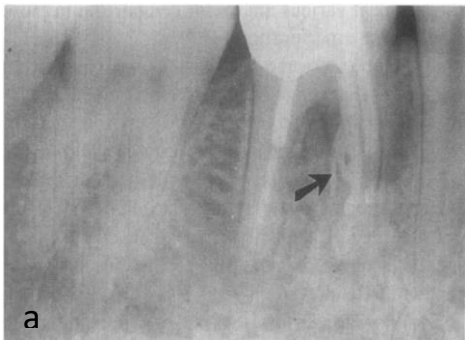
Are often due to a lack of attention to the details of internal anatomy and a failure to consider anatomic variations. Any stage of endodontic therapy can result in iatrogenic perforation. Perforation of the

pulp chamber may occur when the chamber is almost totally calcified as a result of aging or as a reaction to trauma or to an irritant. If the pulp chamber roof and floor approximate each other, perforation may result from the careless plunging of a bur through the relatively thin floor. Perforation may also be created as a result of inadequate removal of the pulp chamber roof that results in misdirection of a bur during access preparation. In a malaligned tooth, perforation may result if a bur is not properly angulated in relationship to the long axis of the tooth. **(Alhadainy, 1994) (Alshamrani et al., 2023).**

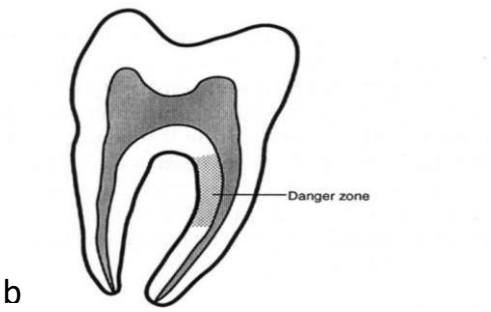
3.1.1 Perforations of the coronal third:-

Perforations of the coronal third often result whilst attempting to locate and open canals , calcifications of the pulp chamber and the orifices, misidentification of canals, significant crown root angulations and excessive removal of coronal dentine can easily result in perforations in the coronal or furcation regions.The narrow mesiodistal diameter at the cervix of lower premolars and lingual inclination of their roots increase the frequencies of coronal perforations in these teeth. **.(Saeed et al., 2016)**. Strip perforations(Strip perforation is a type of root perforation that occurs during root canal treatment, usually when an instrument creates a narrow, elongated hole along the side of the root. It typically happens in curved or difficult-to-navigate areas and can lead to infection or contamination). Treatment involves sealing the perforation to prevent further complications.may result from excessive enlargement of the coronal third of small curved canals(Fig.2a).The furcation area of the coronal third in a small curved root has been described as a “danger

zone". There is less tooth structure in this area compared with the outer canal wall (Fig.2b) .



(Fig.2a). Strip perforation of furcal surface of coronal third(arrow).



(Fig.2b). Furcal aspect of root has more possibility for striping perforation so it is considered the dangerious zone.

3.1.2 Perforation of the middle third:-

Classically this type of perforation occurs in curved molar roots when the instrumentation is too heavy on the inside curvature resulting in a furcational strip perforation (Fig. 3a and 3b). Perforations of the middle third may also occur during the pursuit of sclerosed canals. In these instances the dentist may need to use rotary or ultrasonic instruments well into the root of the tooth risking lateral perforation.**(Saeed et al., 2016).**

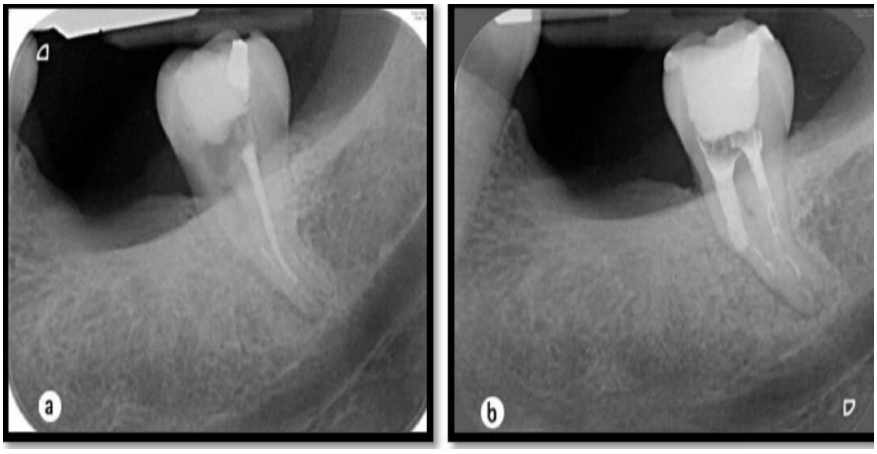


Fig.(3):Not only has an instrument fractured in the mesiobuccal canal of the lower 2nd molar but there has been a perforation of the middle third of the tooth in an attempt to remove and/or bipass the instrument. **(Saeed et al., 2016).**

3.1.3 Perforation of the Apical third:-

Inadequate cleaning and shaping of the canal can lead to blockages and ledges. Once formed, these can cause instruments to deviate, transporting the canal away from the centre of the root, until a perforation occurs. Stiff instruments placed into curved canals may also straighten the canal, causing zip perforations (Figs. 4a and 4b). An apical perforation occurs when the clinician does not respect the apical anatomy and passes endodontic files too aggressively through the apical constriction (Fig.5) **.(Saeed et al., 2016).**

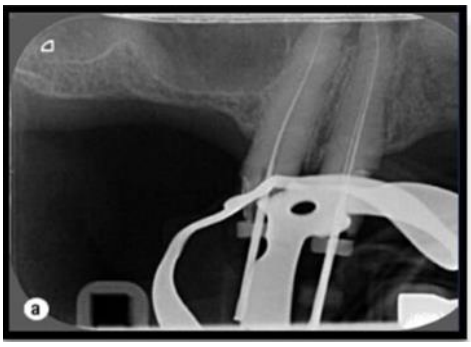


Fig. (4): a) There is an acute curve distally in the apical region of the upper 1st premolar. **(Saeed et al.,)**

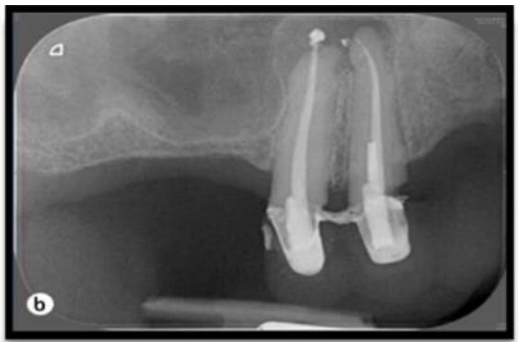


Fig.(4):(b) This has not been respected during instrumentation resulting in straightening of the canal and apical perforation. **(Saeed et al.,)**

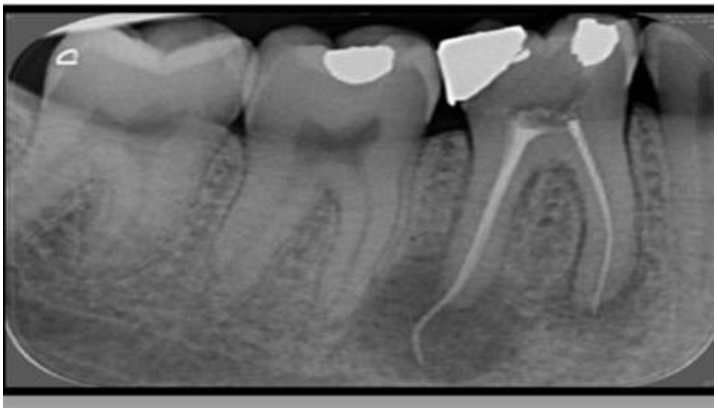


Fig. (5): A lack of control during the distal Canal preparation of the lower 1st molar has resulted in over preparation and significant overextension of the gutta percha**. (Saeed et al., 2016).**

3.1.4 Post space preparation:-

Following obturation, careless post space preparation may result in perforation. Traditional approaches to placement of post retained restorations focus on achieving good length and width for the post. This creates the risk of both apical and strip perforation. Sometimes the post is not placed into the root canal but the adjacent dentine, resulting in catastrophic consequences (Fig. 6). **(Saeed et al., 2016).**

Fig.(6): A threaded post has been placed though the furcation. **(Saeed et al., 2016).**

3.2 Non-iatrogenic perforations (pathologic perforation):-

These can result from root resorption or caries. Root resorption When occurring within the root canal system it is known as internal inflammatory root resorption. It's seen radiographically as an oval shape enlargement of the root canal system. The exact cause is not known, but this process can follow trauma, pulpal inflammation and pulpotomy procedures. Early detection and intervention is essential to control the disease before such an event occurs. External inflammatory root resorption can occur following damage to the cementum and periodontal ligament cells on the root surface. An untreated carious lesion may either

perforate the pulp chamber floor or extend along the root, resulting in perforation of the root. Treatment of these perforations may require root canal treatment , crown lengthening, and either root extrusion or root resection in order to retain valuable radicular segments. Unfortunately, perforation in most of these cases renders the tooth unrestorable . **(Saeed et al., 2016).**

4. Diagnosis of Root perforation:-

Several clinical findings may be determinant in diagnosing root perforations. The clinical and radiographical exams constitute the basis of root perforation diagnosis. **(Tsesis and Fuss, 2006).**

During vital root canal preparation (pulp is emptied), the radicular pulp may be removed by pulpectomy (when the pulp is excised, or when root canals are narrow, removal is by fragmentation). After removal of pulp tissue, persistent bleeding during coronal access or root canal preparation may be a sign of perforation. A paper point with blood may also suggest perforation. Systemic conditions, medications, teeth with an open apex and internal resorption and acute apical periodontitis may be associated excessive bleeding, and be confused with root perforation. Clinically, its diagnosis is a challenge**. (Estrela et al., 2018). (Saeed et al., 2016) (Alhadainy, 1994)** .

However, the apex locator is a technological resource that may help in diagnosing root perforation**.(Tsesis and Fuss, 2006).** Periapical radiography is the imaging method frequently indicated for endodontic diagnosis, treatment plan, and follow-up.A radiolucency associated with a communication between the root canal walls and the periodontal space

constitutes an important vestige of this procedural accident. **(Estrela et al., 2018).**

The incorporation of cone-beam computed tomography (CBCT) in endodontic procedures ensures new parameters to aid in the diagnosis and prognosis of these pathologic and iatrogenic conditions. **(Estrela et al., 2008), (Hassan et al., 2009) (Haung et al , 2010)** , **(Blattner et al., 2010)**,**(Shemesh et al.,2011)** compared ex vivo the sensitivity and specificity of CBCT scans and digital periapical radiographs in detecting strip and root perforations in (45) curved mesial roots of mandibular molars. **(Shemesh et al., 2011)**.

An essential factor to consider is whether or not an endodontically treated tooth is associated with a root perforation. The diagnosis of root perforation in endodontically treated teeth may be complex. Diagnostic errors occur and constitute a serious problem; errors are frequently detected in association with a metallic or solid structure of higher density, which produces an image artifact, lacking homogeneity and being defined by image contrasts. Misdiagnosis is a serious problem that has encouraged the search for alternatives to reduce the beam hardening effect during image acquisition and reconstruction. **(Pauwels et al., 2014**) ,**(Katsumata et al., 2006) , (Azevedo et al., 2008)**.

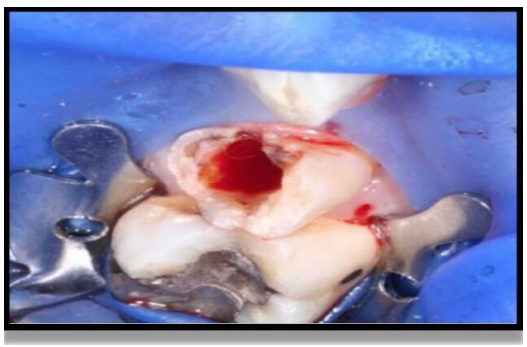


Fig.(7): Profuse bleeding resulting from A perforation during endodontic access of the 15 (Saed et al., 2016).

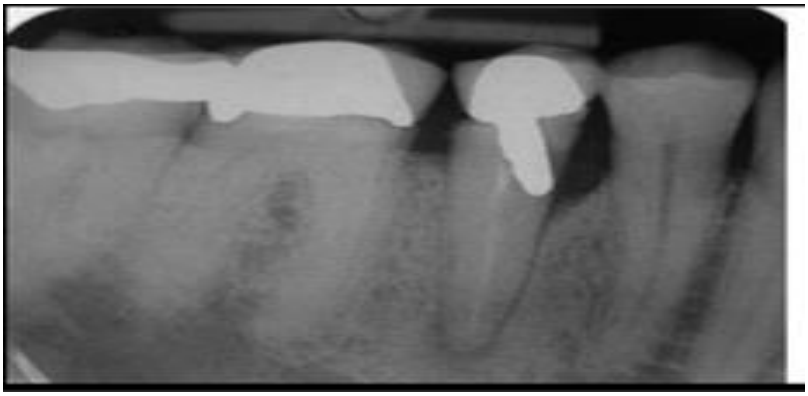


Fig.(8) : The post in the 45 perforates the mesial aspect of the root wall. A periodontal pocket has resulted from the chronic inflammation (Saed et al., 2016).

5.prognosis:-

Root perforation could affect the prognosis of root canal treatment and retreatment.Three clinical factors have been considered as relevant in the prognosis and healing of root perforations**. (Tsesis and Fuss, 2006).**

5.1 Site of perforation:-

The position of the perforation relative to the level of the crestal bone and the epithelial attachment is critical when assessing prognosis. This is named the critical zone as in (Fig.9) ,The worst prognosis lies when the perforation is within this critical zone. The close proximity to the gingival tissues can lead to the contamination of the perforation with bacteria from the oral cavity. **(Tsesis and Fuss, 2006).**

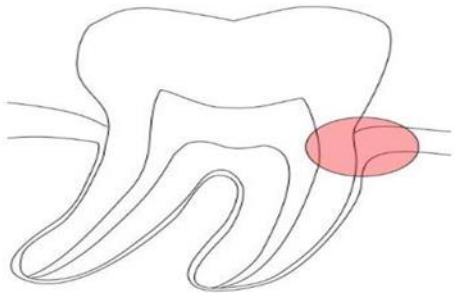


Fig.(9) :The critical zone: a perforation into the gingival sulcus and the crestal attachment may have the most significant consequences as bacterial entry and pocket formation can quickly ensue. It is important to recognise the critical zone may not necessarily be at the CEJ but rather follow the biological width, thus if there is recession, the critical zone will be located more apically accordingly. **(Saed et al., 2016).**

5.2 Size of perforation:-

(Himel et al.1980) studied the mandibular teeth of the dogs to study the influence three materials that was used for healing the perforations of the pulpal floor and it was noticed that the larger teeth that has smaller perforations had greater incidence of healing. A small perforation is usually associated with less tissue destruction and inflammation .Therefore, healing is more predictable and has a better prognosis .Smaller perforations are easier to seal effectively, preventing bacteria from reaching the periradicular tissues**.(Hegde at al., 2017).**

5.3 Time of perforation:-

Time is a most critical factor determining outcome of treatment. **(Beavers et. Al,.1981)** observed consistent periodontal healing following treatment of experimentally produced root perforations in a monkey model. **(Lantz & Persson et ,.al..1083)** produced root perforations in dogs that were treated either immediately or after some delay. The most

favorable healing response was evidenced when perforations were sealed immediately. Proper treatment of the perforation may not always be possible, due to lack of time, lack of experience of the operator, and proper equipment.**(Singh et al., 2016).**

Table 1: classification of root perforation

(Baumann and Beer, 2010).

Good prognosis	Poor prognosis
Fresh	**Old**
Small	**Large**
Apical –coronal	**High alveolar ridge**

6. Materials Used For Perforation Repair:-

An ideal material used in the management of root perforation material is still challenging. The endodontic literature published over the years presents reports on several intracanal medicaments that have been studied to treat infected root canals.There are various materials used for perforation repair :-

6.1 Bioceramic:-

This is a bioceramic material which refers to a mixture of calcium silicate **(Hegde et al., 2017):**

6.1.1 Endosequence:-

It is bioceramic material composed of calcium silicates, zirconium oxide, tantalum oxide, calcium phosphate mono basic and filler agents. It has a working time of more than (30 minutes) and a setting reaction initiated by moisture with a final set achieved in approximately(4 hours). Bioceramics can be used in two forms either as premixed putty or in a premixed syringe. The syringe eliminates need of hand instruments and also need for mixing. The bioceramic particle size is less than (2 µ)thus can be delivered by a (0.012) capillary tip which allows premixed material to be placed by syringe (Fig. 10) **(Hegde et al , 2014).** Nanosphere particles are produced which enables the material to enter in the dentinal tubules and thereby initiating the setting reaction by interacting with the moisture, this creates a mechanical bond on setting and makes it dimensional stable, The material also shows superior biocompatibility characteristics due to its high pH **(Damas et al., 2011) (Nasseh A, 2009)** (Jeevani et al.,2014).conducted a study on furcation repair with Endosequence, biodentine and MTA and showed that endosequence has better sealing ability compared to others. **(Jeevani et al., 2014).**

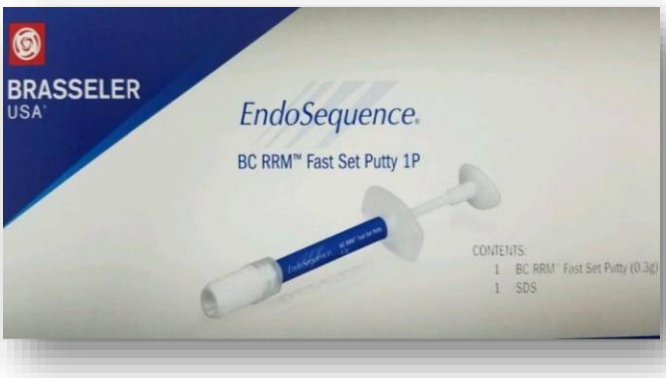


Fig.(10): Brasseler Endosequence Root Repair Material (Brasseler USA). This material has better handling characteristics than MTA and minimizes discoloration of the tooth. (Berman et al 2021).

6.1.2 Bioaggregate:-

Is a bioceramic material composed of tricalcium silicate, dicalcium silicate, calcium phosphate mono basic, amorphous silicon dioxide and tantalum pent oxide. It promotes mineralized tissue formation and leads to precipitation of apatite crystals that become larger which increases on immersion time suggesting it to be bioactive **(Zhang et al, 2009).**

6.2 Calcium Hydroxide:-

In 1920s, Bernhard W. Herman suggested the use of calcium hydroxide for dental pulp treatment. This material favors the healing process of pulp and Periapical tissues. It's obtained by the calcination of calcium carbonate, which is transformed into calcium oxide, and then hydrated to form calcium hydroxide. The reaction between calcium hydroxide and carbon dioxide forms calcium carbonate. The ionic dissociation of calcium hydroxide into calcium and hydroxyl ions, and the action of these ions on tissues and bacteria explains its biological and antimicrobial properties. It is one of the most biologically compatible material which is used in dentistry. It is very much compatible with the pulp and the periapical tissue **(Estrela et al., 1995) (Sharma et al., 2020).** By composition calcium hydroxide consists of a base paste and catalyst paste. When root perforation detected in teeth with infected root canals, calcium hydroxide is the first antibacterial option for intracanal dressing. The sanitization process (emptying, irrigation, enlargement, intracanal medication) has led to significant reduction of microorganisms in contaminated root canals. Calcium hydroxide paste may be prepared with a saline solution vehicle (water- soluble in nature). Its placement should be very well condensed within the root canal to avoid empty

spaces when filling the root perforation. Its consistency must be thicker than toothpaste. Proper management and placement of calcium hydroxide paste into the root perforation are necessary for better performance of this intracanal dressing. In the second appointment, the calcium hydroxide is removed from the root canal and from the site of root perforation with the residual paste acting as a matrix , taking care to avoid overfilling. The root perforation is then sealed with mineral trioxide agregate **(Estrela et al., 2018)(Holland et al , 2017).**

6.3 Calcium silicate based cements (biodentine):-

It's a based cements has a powder liquid system in which powder consist of Tri-calcium silicate, Dicalcium silicate, Calcium carbonate and oxide such as Iron oxide, Zirconium oxide and Liquid consist of Calcium chloride, Hydro soluble polymer. Biodentine has shorter setting time approximately (12 minutes) and it is easy to handle and has high alkaline pH which makes it a biocompatible material and thus making it a favorable material for perforation repair. a study by **(Guneser et al.,2013)** on Biodentine showed considerable performance as a perforation repair material even after being exposed to various endodontic irrigants as compared to MTA (Fig. 11-a-d) **(Guneser et al., 2013) (Priyalakshmi and Ranjan, 2014) (Han and Okiji , 2011) .**

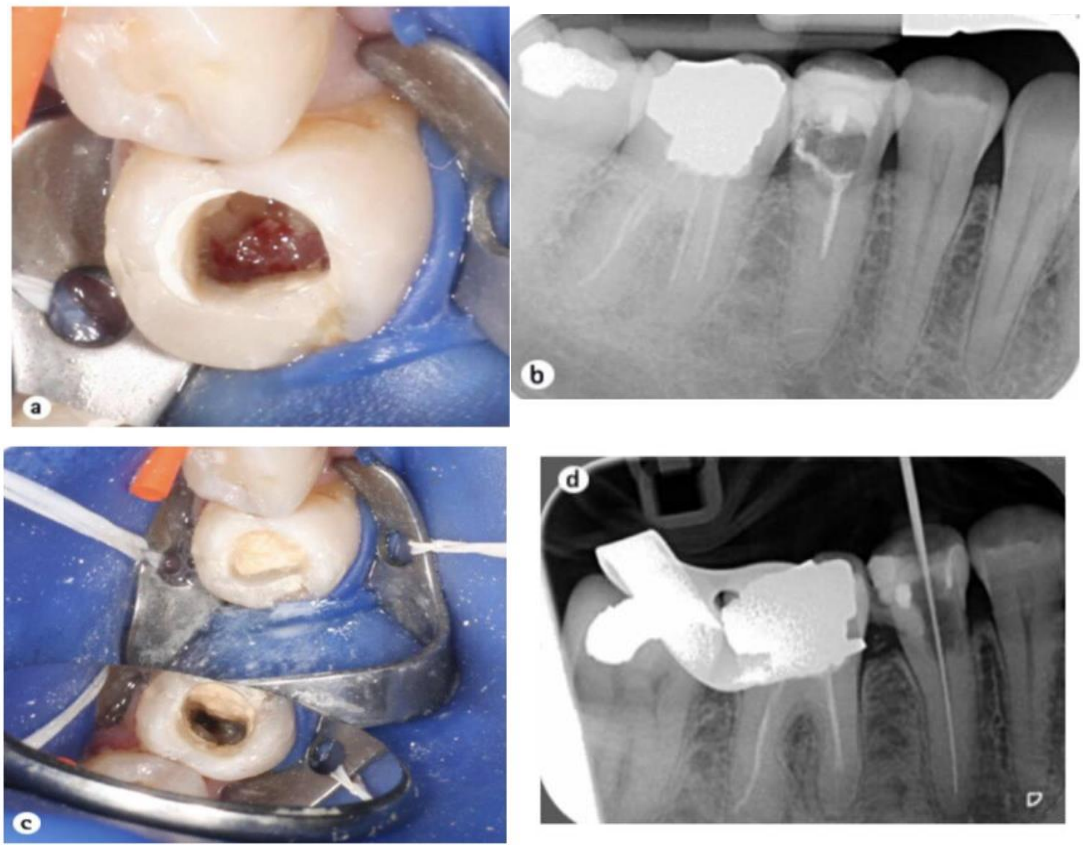


Fig.(11): a-b) A perforation occurred during Endodontics access of the 45).c-d) The cavity was repaired with Biodentin. The setting time of (12 min. allowed the operator to continue RCT without significant delay to the patient's care.**(Saeed et al., 2016).**

6.4 Mineral Trioxide Aggregate (MTA):-

Mineral trioxide aggregate (MTA) has been considered as an ideal material for perforation repair, apexification retrograde filling, pulp capping etc. MTA is a mineral powder that is made up of hydrophilic particles, whose principal components are dicalcium silicate, tricalcium of slica aluminium and oxide along with other mineral oxides.**(Main et al , 2004)** . When mineral trioxide aggregate was introduced for perforation repair, the choice of which repair material to use became more clear. MTA has many advantages over previous restoratives when being used for perforation repair , The materials seals well even if the cavity

preparation is contaminated with blood , It's very biocompatible rarely eliciting any response from the periradicular tissues, and a cementum like material has been consistently shown to grow directly on the material after placement, MTA has also been shown to have a high degree of clinically favorable long-term outcomes when used as a perforation repair material**.(Berman et al., 2021).** MTA is available in the original gray formulation and an off-white formulation (Fig.12), Their sealing ability seems comparable **(Ferris &Baumgartner , 2004) ,(Mozynska et al , 2017) (Berman et al 2021).**

Fig.(12): MTA is available in the original gray- colored preparation (left), and the newer white-colored version (right). The latter is indicated for esthetically demanding areas of the mouth **(Baumann and Beer, 2010).**

Disadvantages of using MTA:-

- It is difficult to manipulate and handling requires both time and practice.
- The setting time of around (3-4) hours may compromise the application .

- Both grey and white MTA can discolor the tooth and therefore compromise aesthetics. This needs to be considered especially in the anterior region and with those patients who have a high lip line**.(Clauder&Shin ,2006) (Saeed et al., 2016).**

7. Management of Root Perforation:-

Successful perforation management involves adequately sealing the breach, using the right material, and closing the perforation in the right place as soon as feasible. The successful treatment depends mainly on immediate sealing of the perforation and prevention of infection**.(Baumann and Beer, 2010).** Perforation management can be done in one of two ways: non-surgically or surgically**.**

7.1 Non – surgical:-

7.1.1 Orthograde approach:-

Fresh perforations that occur during endodontic and operative procedure are followed by hemorrage. Hemorrage can be controlled first by applying pressure or irrigation and perforation should be sealed adequately**.(Tsesis and Fuss, 2006).** Bleeding can be controlled using hemostatic agents and materials that arrest bleeding. To control bleeding, calcium hydroxide can be syringed into the canal and allow to remain for (4–5 min) and then flush calcium hydroxide using (NaOCl), repeat this procedure for(2–3 times)**.(Kim and Rethnam, 1997) (Senthilkumar and Subbarao, 2017)**. Other hemostatic materials used to control bleeding are collagen, calcium sulfate, freeze-dried bone, and mineral

trioxide aggregate**(Koh et al., 1998)(Behnia et al., 2000) (Senthilkumar and Subbarao, 2017).**

7.1.2 Crestal root perforation management:-

Any biocompatible substance with a quick setting time and good sealability should be used for sealing. For single rooted teeth, it is advised to use. orthodontic extrusion to move the perforation to the coronal position, where it can be superficially sealed without the need for surgery. **(Kim and Rethnam, 1997).** To prevent the ejection of repair material, internal matrix method is advised for significant perforations in the furcal zone of molars **(Rafter et al., 2002).** The finest materials for furcation perforation include MTA, iRoot BP, calcium-enriched mixture cement, Pro-root MTA, and biodentine**.(Kerner and Bronnec, 2015)** ,Cementum like tissue is created when MTA and a cement mixture high in calcium are used. The optimum material for crestal root perforations is thought to be biodentine. In the treatment of perforation, the application of stem cells in combination with a cured dentin matrix improves bone development. **(Bakhtiar et al, 2017) (Alshamrani et al., 2023).**

7.1.3 Intentional replantation:-

When orthograde and invasive procedures are not an option, this approach is taken into account. It is indicated when the perforation is too large to heal and impossible to reach without removing a lot of bone. The tooth should be extracted gently without causing any harm to the nearby tissues. A balanced salt solution should be used to gently wash the tooth after removal while it is being held in forceps. Replanting needs to be

carried out as soon as feasible. Ankylosis and inflammatory root resorption are complications**.(Tsesis and Fuss, 2006).**

7.1.4 Iatrogenic Perforation:-

The prognosis will be better, the more apically the perforation is located. A negative prognosis is associated with perforations that develop in the coronal third of the root underneath the crestal bone. In cases of strip perforation, MTA can be utilized as an obturating agent and perforations situated at the point of epithelial attachment and bone. **(Adiga et al,. 2010) (Alshamrani et al., 2023).**

7.2 Surgical management:-

Large perforations, perforations brought on by resorption, and lack of healing following non-surgical repair all call for surgical intervention. The amount of surviving bone, the degree of osseous destruction, the age of the defect,the presence of periodontal pathology, the extent of soft tissue attached, dental hygiene, and the surgeon's skill in managing tissue are all factors taken into account before surgical therapy. **(Tsesis and Fuss,(2006))**

Perforation is being managed with guided tissue regeneration. An elevated buccal full thickness flap enables the perforation location to be seen. MTA is then used to close the perforation, and the flap is sutured after that. Sutures are extracted from postoperative wound after they have healed, and the postcan then be sealed (Fig.13). **(Nagpal et al., 2013) (Alshamrani et al., 2023).**

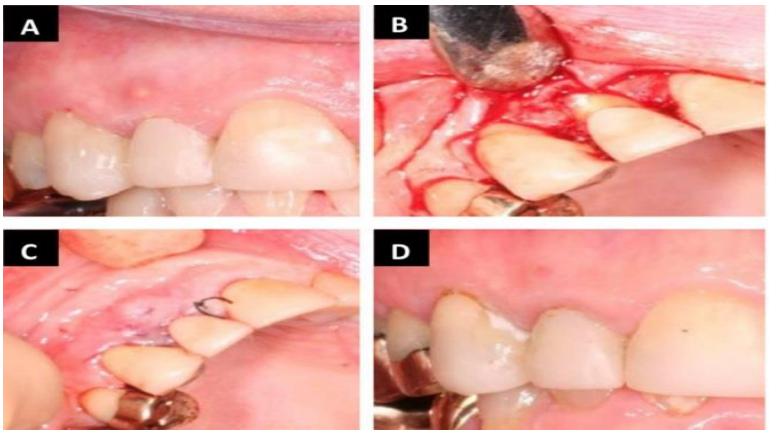


Fig.(13) : Surgical management of perforation a) A perforation occurred during RCT of the 12 resulting in a persistent sinus. b–c) An intra-sulcular incison was made and a flap raised without relieving incisions. Surgical repair with MTA was performed. d) There was evidence of healing and no pocketing at a 4week review.

8. Prevention of perforation:-

To avoid perforation during endodontic treatment we have the following key concepts: **(Ricketts et al., 2005) (Saeed et al., 2016).**

Use magnification and good illumination when providing endodontic treatment.

 Remove impediments to straight line access, this reduces the curvature of the canal.

 Begin a crown down approach before apical instrumentation. This facilitates instrumentation, prevents instruments locking in the canal and allows improved irrigation.

 Negotiate canals initially with size(10 ISO) files and progress to size (20 ISO) files before introducing rotary instruments.

 Use ‘fine files frequently’ between larger files to prevent blockages and ledging.

 Use copious irrigation with(1%-5.25%) sodium hypochlorite to remove debris

 In curved canals use balanced force technique for hand filing.

 Always follow manufacturer guidelines on rotary instrument protocols.

 Never force a file.

 If you suspect a blockage or ledge, do not use rotary instruments.

 In teeth with multiple roots always file away from the furcation with brush strokes of the instruments.

 If there is any doubt about access, working length or possible perforation, take a check radiograph.

Chapter Three

Discussion

The life of an endodontically treated tooth is associated with correct diagnosis and treatment planning, root canal shaping, sanitization, sealing, and lastly, tooth rehabilitation. The successful treatment of a root perforation depends on certain factors, like sealing material, perforation extent and location, time between diagnosis and treatment, presence of contamination and related operator experience, presence of preoperative lesions, communication of the perforation with the oral environment, and type and quality of the final restoration. MTA is highly biocompatible and offers excellent sealing ability, making it ideal for procedures like apexification and root-end filling. However, it has a long setting time and can be brittle.It promotes dentin regeneration and has strong antibacterial properties, making it useful in pulp capping. However, it lacks mechanical strength and long-term sealing ability, which limits its use in root canal fillings biodentine is similar to MTA but offers a faster setting time and better mechanical properties. It is easier to handle and provides excellent biocompatibility and sealing ability, making it a good alternative to MTA bioceramics provide the best sealing ability, excellent biocompatibility, and superior mechanical strength. They are ideal for complex cases but are more expensive and harder to manipulate compared to other materials.

Chapter Four

Conclusion

Chronic infections brought on by perforations can eventually lead to tooth loss. All medical interventions must include measures to reduce iatrogenic harm. Perforations can, and often do, happen for a wide range of reasons. The physician must be able to spot a perforation when it occurs and know the best course of action for repairing the injury. All practitioners should think about doing an appropriate repair right away. Delaying treatment by referring to a more skilled peer may have a substantial bearing on the therapy's outcome. The drawbacks and benefits of either keeping the tooth untreated or having it extracted and replaced with a prosthesis must be explained to patients before they give their assent. Long-standing perforations may be challenging to correct.

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