

## Internal Root Resorption - A Review

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### ABSTRACT

Root resorption is defined as a condition associated with either a physiologic or a pathologic process, that result in the progressive or transitory loss of cementum or cementum/dentin or alveolar bone due to odontoclastic activity. Most of the documentation that exists in the writings is found within the case reports, and there are a limited number of considerations that have attempted to look at the histological manifestations and the biological outlook of infection. This may be due in part to this moderately rare event of resorption, and requires in vivo proof to separate from past efforts using diathermy to typically replicate the research conditions. From a histological point of view, the internal root absorption is shown in a frame that is only destructive, the internal (root canal) is inflammatory absorption, and the other is through repair, the internal (root canal) ) Replacement absorption is emphasized by the metaplastic bone/cement term. The tissue is close to the absorption site. From the perspective of differential diagnosis, the emergence of cone-beam computed tomography has greatly improved the ability of clinicians to diagnose internal root resorption. In any case, so far, root canal therapy is still the first choice for this pathological condition.

### Keywords:

Osteoclasts. Inflammation. Root Resorption

### 1. Introduction

A resorptive defect inside the root canal is internal root resorption. It is followed by the necrosis of odontoblasts due to chronic inflammation and invasion of the bacteria into the pulp (Fig. 1.1).



**Fig.1.**

This happens because the normal tissue of the pulp transforms into granulomatous tissue with giant cells, which dissolve the dentine. Because of this activity there is chronic inflammation of the coronal pulp which takes place by continuous bacterial stimulation.

## 2. Etiology and Pathogenesis

The reasons for the loss of odontoblastic layer and predentin are mentioned below:

Trauma to the teeth,

Dental Caries,

Itrogenic procedures,

Crown cutting or Restorative procedures,

Extreme heat is produced when preparing a cavity with inadequate water spray through the handpiece.

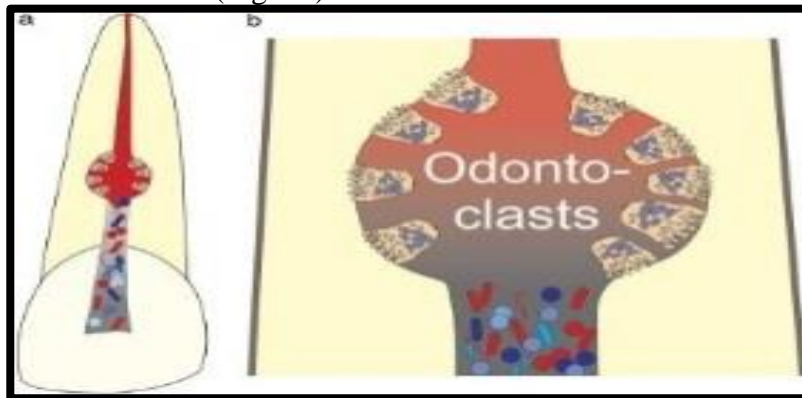
Orthodontic procedures.

Presence of chronic inflammatory tissue in the dental pulp.

Idiopathic.

Odontoclasts which are morphologically similar to osteoclast resorb dental hard tissues. The difference between Odontoclasts and osteoclasts is, odontoclasts are small in size with less number of nuclei compared to osteoclast. Odontoclast also have smaller sealing zones because of differences in their respective resorption substrata<sup>1</sup>. The resorption of the target tissue takes place in a similar manner by both, osteoclast and odontoclast<sup>2</sup>. Osteoclasts and odontoclast have same enzymatic properties. These cells form a resorption depression which is termed as a Howship's lacunae. This lacunae form on the surface of the mineralized tissues<sup>3-4</sup>.

A common hematopoietic lineage is shared by dendritic cells and the multinucleated osteoclasts. Previously they have been called as immunologic defense cells. Later it was pondered that immature dendritic cells work moreover as osteoclast precursors that have the capacity to transdifferentiate into osteoclasts (Fig 1.2).

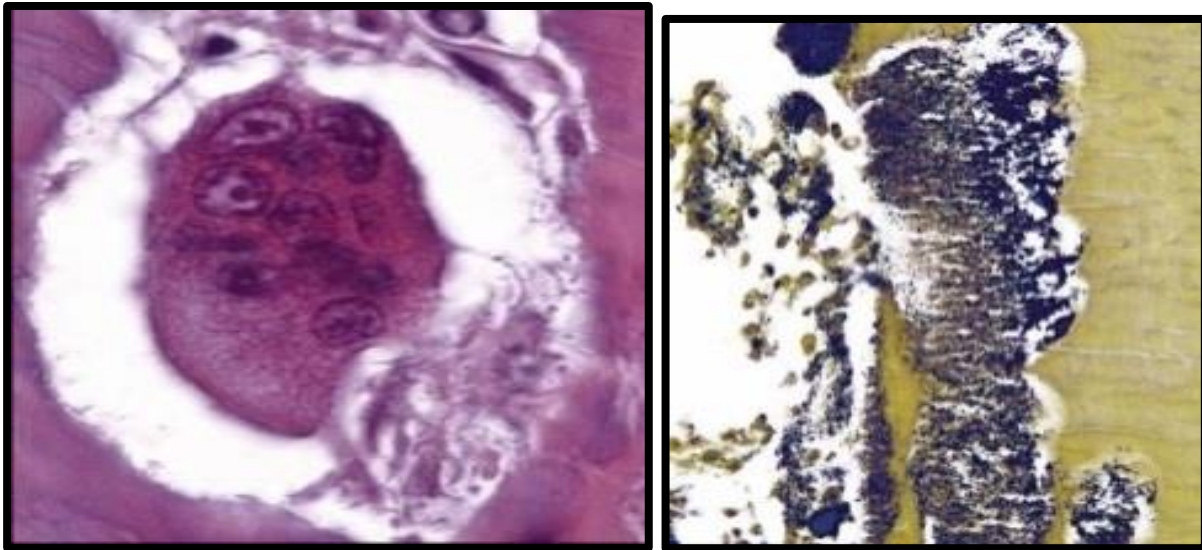


**Fig.1.2**

It is a possibility that because of presence of dendritic cells in the connective tissue might serve as antecedents for odontoclasts.

The accessibility of osteoclast is shown in the table 1<sup>5</sup>.

Osteoclasts may be shown to not bind to the network of nonmineralized collagen. The nearness of a noncollagenous, natural odontoblastic layer and predentin restrains eating up of the canal wall. As compared to cells which causes bone resorption, the cells which causes dentin resorption may bind to proteins having the RGD peptides<sup>6</sup>. This root resorption will take area handiest if the insulating odontoblast layer and the predentin are broken, which results in publicity of the underlying hard tissue to odontoclasts<sup>7</sup> (Fig. 1.3).



**Fig. 1.3**

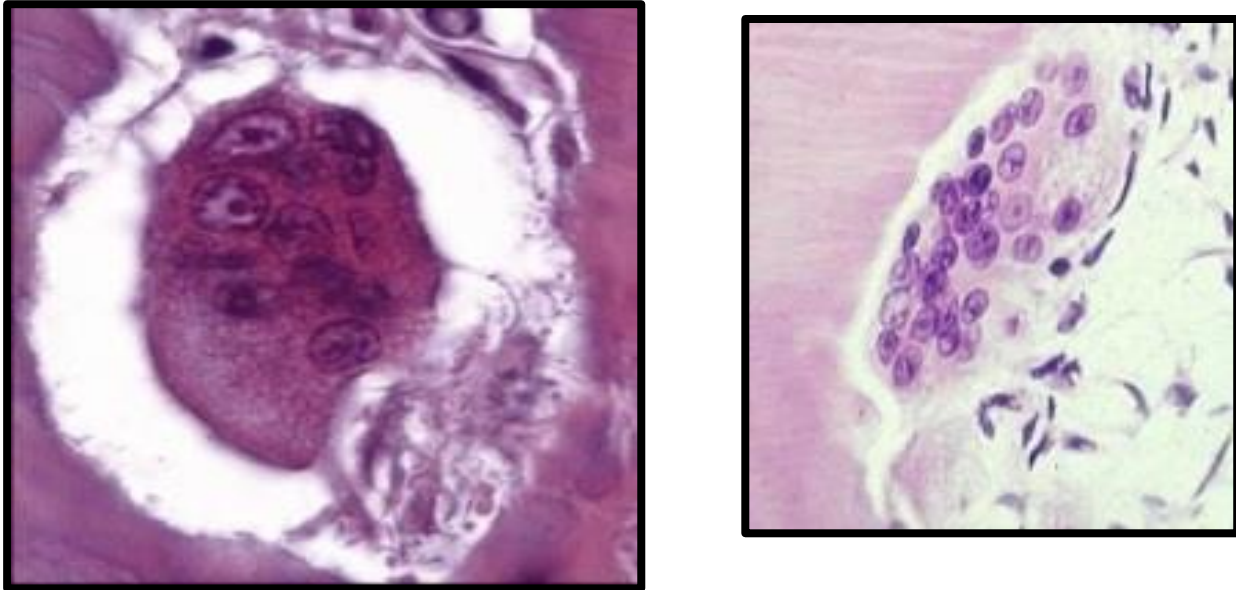
Internal root resorption occurs due to harm in odontoblastic surface and predentin.<sup>8</sup> Hence, the development of this type of defect relies upon on bacterial stimulation of the clastic cells involved in challenging tissue resorption<sup>9</sup>. The resorption might be self-proscribing in the loss of this stimulus. Internal root resorption will happen handiest if, the connective tissue below the resorptive lesion should have a potential blood delivery, so that it can offer the clastic cells necessary vitamins. Likewise the infected necrotic coronal pulp tissue will offer stimulation for those clastic cells<sup>10</sup>.

### **Prevalence**

It is frequently seen more in male than female. Internal root resorption is classified as intraradicular or apical depending on the place where it occurs<sup>11</sup>. Although it is an unusual pathological disorder after physical injuries, teeth that have undergone complex medical procedures such as auto transplantation have a high incidence of the condition<sup>12</sup>. Defect at the apex is a relatively seen in teeth with infection in periapex<sup>12</sup>.

### **Histologic Manifestations**

The histochemical profiles and histologic picture of the primary and permanent teeth are similar. The difference is in the resorption process which is faster in primary teeth. Inflamed pulp tissue is composed of primarily lymphocytes and macrophages, little neutrophils<sup>12</sup> (Fig.1.4).



**Fig. 1.4**

With the dilated blood vessels there was evidence of presence of inflammation. Following the lesion, bacteria were discovered in the nonvital pulp tissue in the crown and inside the tubules. Granulation tissue has less blood supply than normal pulp and the same periodontal connective tissues as normal pulp, but with more cells and fibers<sup>12</sup>. Also metaplastic mineralized tissue is detected histologically which is similar to bone or cementum. The pulp cavity is partially lined by this tissue in all cases<sup>12</sup>.

### **Internal (Root Canal) Inflammatory Resorption**

**Definition:** It is very rare entity which initiates inside root canal and breaks adjacent dental hard tissues<sup>13</sup>. It takes place in any part of the canal. Ovalshaped enlargement is characteristic feature which can be seen on radiograph<sup>13</sup> (Fig. 1.5).



**Fig. 1.5**

Within the manner of the resorption, pulp tissue in the crown turns dead, however the pulp tissue at the apex remains essential for the development and growth of the lesion<sup>13</sup>. Until the perforation of the root canal system takes place this condition remains undiagnosed. Whilst the resorption

takes place in coronal pulp , it reveals a feature pinkish hue this is describe as the pink teeth of Mummery<sup>13</sup>.

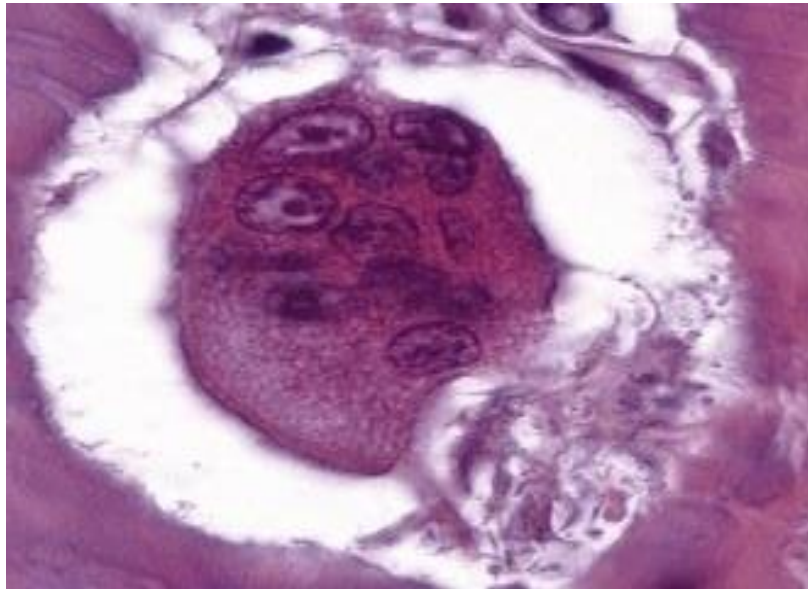
This is commonly associated with chronic inflammation of the pulp. The granulation tissue consists of bacteria when the lesion is progressive in nature.

### **pathogenesis**

This has relative uncommon occurrence, which is likely why its aetiology is unknown. to reveal mineralized tissue to pulpal cells with resorbing capacity, damage to the natural sheath, predentin, and odontoblast cells protective mineralized dentine must be a gift<sup>14</sup>

### **Hypothesis for internal inflammatory root resorption<sup>15</sup>**

According to one theory, the nonvital and infected coronal portion of the pulp stimulates inflammation in the apical part. Another theory proposes that dental pulp cells and odontoblasts die at some point of tooth development and in response to specific styles of injury. (Fig.1.6).



**Fig.1.6**

The end result of injury, caries which produces cytokines is death of odontoblasts or pulpal fibroblasts, triggering this type lesion terminating end of the pulp. (Fig 1.7)



**Fig.1.7**



Internal resorption best takes place while the predentin adjacent to persistent infection is destroyed on account of damage or other unexplained etiologic elements<sup>15</sup>.

### 3. Clinical and radiological features

Oral root resorption has different clinical manifestations depending on how it develops and where it occurs. The majority of teeth with this type of defect have no symptoms<sup>16</sup>. When the lesion is proceeding, partially alive tooth exhibiting pulpitis-like symptoms<sup>16</sup>. If the resorption happens in or across the crown, the pink tooth of Mummery may show via the crown in advanced cases as a pinkish or reddish colour if best a skinny layer of tooth is left to cover the resorption.<sup>16</sup> (Fig. 1.8).



**Fig.1.8**

The red color is due to highly vascularized tissue adjacent to cells responsible for resorption. The color ('pink spot') in internal resorption is usually central, while the color ('pink spot') in cervical resorption is in mesial or distal side<sup>16</sup>. If the pulp becomes necrotic, and the condition is not treated then the teeth turns gray<sup>16</sup> (Fig. 1.9).



**Fig.1.9**

When the perforation of the canal occurs then then a sinus track develops giving the information

about the presence of canal infection<sup>17</sup>. Because the resorbing cells can now receive nutrients from tissues surrounding the tooth after the perforation, the continuation of the resorption may not be contingent at the involvement of essential pulp tissue.<sup>17</sup> (Fig. 1.10).



**Fig.1.10**

except root perforation has befall till the development of complete necrosis<sup>17</sup>, the entire pulp turns into necrotic and inner root resorption ceases whilst the resorbing cells are cut off from stream and nutrients. As a end result, pulpal necrosis can be taken into consideration an critical barrier to the dissemination of resorption. Apical periodontitis is the clean expectation of pulp necrosis. Internal inflammatory root resorption is enormously trustworthy to hit upon radiographically in its maximum classic shape, and the proper analysis may be made. The resorption is visible as a radiolucent, oval, and enlarged. The original canal shape can no longer be seen in the resorption region.

### **Diagnosis**

This type of lesion is usually discovered first on radiography. Since teeth with this defect are symptom-free<sup>18</sup>, often lesions are discovered by mistake during routine check-up radiographs. As previously stated, diagnosing symmetrical, circular, or oval lesions in the root canal is easy. For more irregularly shaped resorptions, disappearance of the canal is main striking characteristic<sup>18</sup> (fig. 1.11).



**Fig.1.11**

Cervical resorption spread across the tooth's cervical region, including sections of the crown and

the root's most coronal portion. When compared to internal resorption in the same region.

#### 4. Internal (Root Canal) Replacement Resorption

##### Clinical & radiologic feature

Diffuse enlargement of the pulp chamber is the key feature of this defect<sup>18</sup>. Illness is covered as part of the canal area due to initiation of the resorption manner inside the canal area, therefore the unique anatomy of the canal seems to be distorted<sup>19</sup> (Fig. 1.12).

This condition is generally asymptomatic. The affected tooth responds generally to thermal and/or electric powered pulp testing unless there's a perforation of the crown or root component. Beginning issue for this lesion to happen is a low-grade irritation of the pulpal tissues consisting of continual irreversible pulpitis or partial necrosis<sup>19</sup>.

##### Histologic feature

On histological evaluation there is deposition of a metaplastic hard in the intraradicular dentin which is similar to bone or cementum<sup>20</sup>.

Metaplasia refers to a reversible change in which one grownup cell type (epithelial or mesenchymal) is replaced via every other cellular type<sup>20</sup>. in the gift context, the metaplastic tissue seems lamella-like, with entrappe osteocyte-like cells that resemble osteons of compact bone<sup>21</sup>.(Fig.1.13)

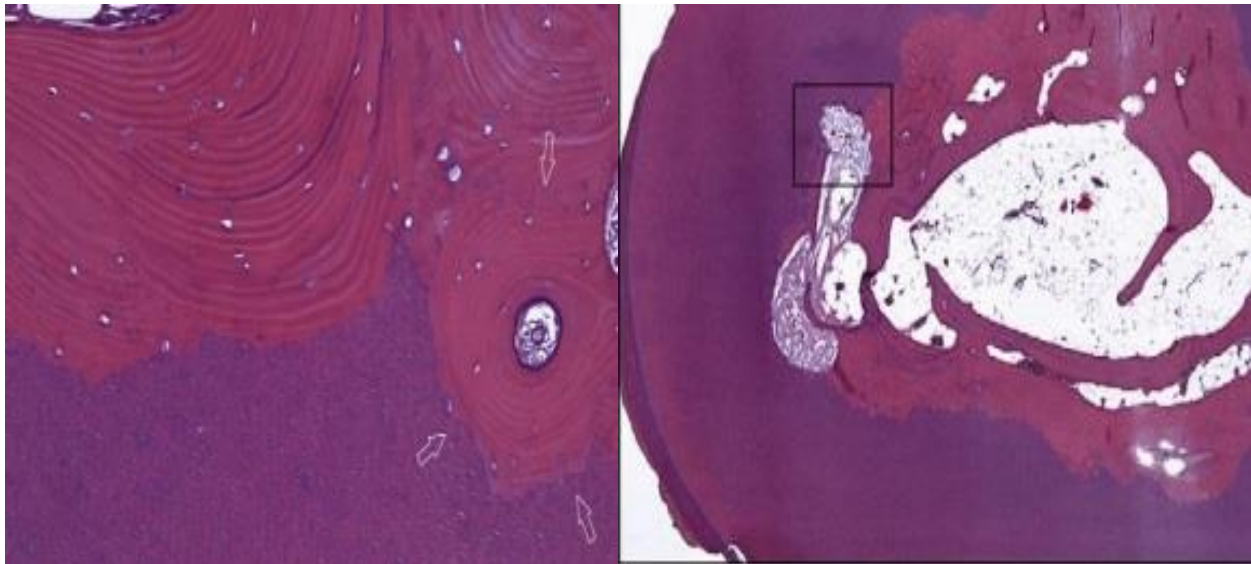


Fig.1.13

##### Hypothesis for internal replacement root resorption

The first theory proposes that postnatal dental pulp stem cells found in the apical, essential portion of the root canal develop metaplastic tissues as a reparative reaction to the resorptive insult<sup>22</sup>. This is similar to odontoblast-like cells forming tertiary reparative dentin after primary odontoblasts have died.<sup>22</sup>.

The matrix accumulated in reparative dentinogenesis frequently resembles osteoid rather than tubular dentin, as a result of the loss of epithelial-mesenchymal connections that occur during



primary dentinogenesis<sup>22</sup>. Odontoblasts are a type of postmitotic cell. Multipotent stem cells involved in dentin repair maintain an osteoblastic phenotype and secrete a matrix that resembles bone rather than dentin in step with every other speculation the granulation tissues and metaplastic difficult tissues are of nonpulpal origin. the ones tissues might be derived from cells that transmigrated from the vascular booths or originated from the periodontium<sup>22</sup>.

This theory proposes that the pulpal tissues are replaced by periodontium-like connective tissues during internal resorption. This is similar to what happens as connective tissues expand into the pulp space and a blood clot becomes available, or, more recently, during pulpal revascularization procedures.<sup>22</sup>.

## 5. Differential Diagnosis

The patient can exhibit pulpitis symptoms if the pulp is only partially vital. In the case of inactive resorption with necrotic pulp, however, the patient can experience apical periodontitis symptoms. The patient can develop a sinus track on clinical inspection, which is inconclusive of the existence of root perforation. Internal root resorption in the coronal third of the root canal can cause a pink discoloration noticeable through the crown of the tooth<sup>23</sup>. As a result, the observation of pink spots alone cannot be used to make a differential diagnosis of internal root resorption. For distinguishing internal and external resorption defects, parallax radiographic techniques are recommended<sup>23</sup>. The extent of the resorptive lesion is also determined by radiographs obtained from a different perspective. With the introduction of cone beam computed tomography (CBCT), radiographic diagnosis has improved. When compared to traditional radiography, CBCT has better 3-dimensional geometric precision.<sup>23</sup>.(Fig.1.14)

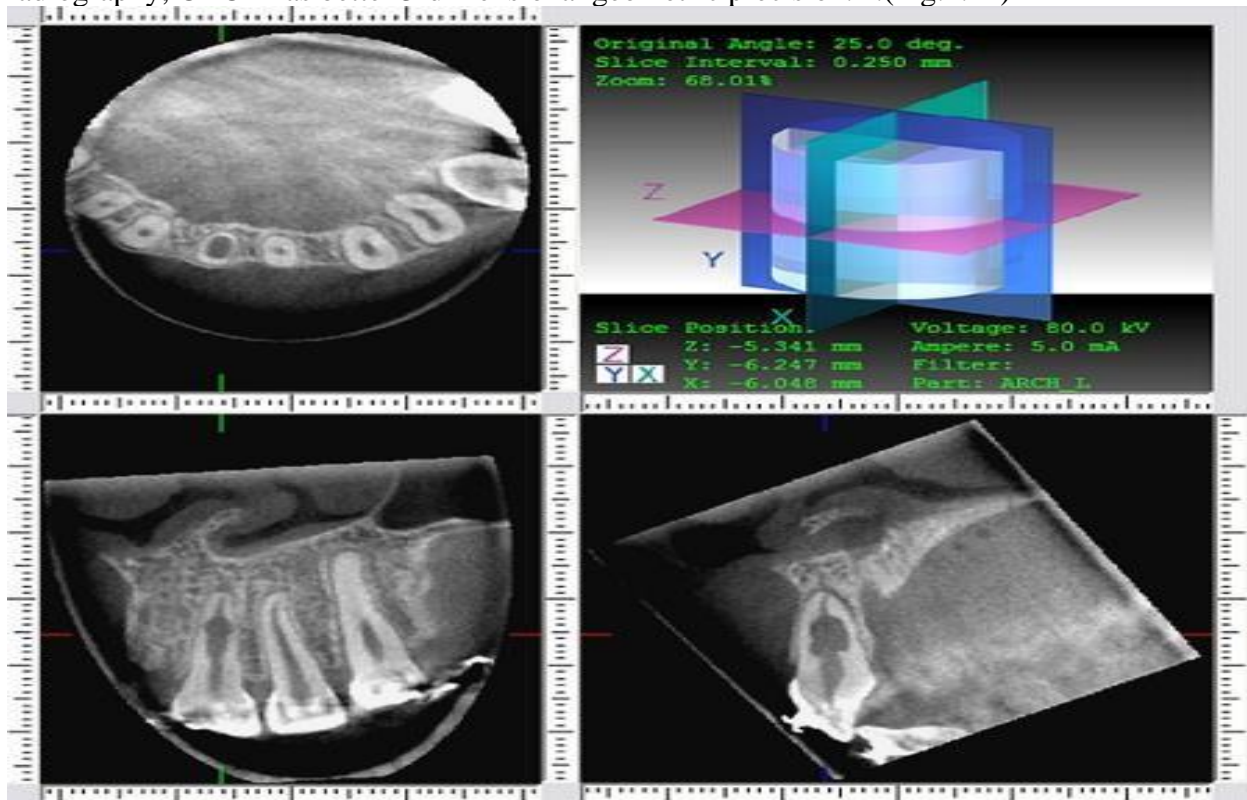


Fig.1.14

## 6. Prognosis

If the tooth is deemed restorable and has a reasonable prognosis, root canal treatment is the remedy of preference in inflammatory root resorption. Since the eventual outcome of internal replacement resorption is the loss of tooth, it may be advantageous to treat the tooth endodontically, in spite of the fact that it may lead to a poor prognosis owing to the lack of root maturity<sup>24</sup>.

## 7. Vitality Testing

Teeth with vital pulps are more prone to internal root resorption and respond to sensitivity testing. It is a common finding that teeth with this condition denotes a negative response to sensitivity checking out because of necrotic coronal pulp tissue and the active resorbing cells are at the apical area<sup>24</sup>. Also, the pulp might have become necrotic after active resorption has taken place<sup>24</sup>.

## 8. Treatment Perspectives

Non-surgical repair

Surgical repair 4

### Non-surgical repair

Any residual essential pulp tissue, necrotic pulp tissue, and granulation tissue are removed during root canal treatment<sup>25</sup>. Preparation of the access cavity should be cautious, maintaining as much tooth structure as possible, and avoiding further deterioration of the already damaged tooth.<sup>25</sup>.

Bleeding from the inflamed pulpal and granulation tissues may be profuse in teeth with aggressively resorbing lesions, obstructing vision during the early stages of chemomechanical debridement. Direct mechanical instrumentation is normally unavailable due to the form of the resorption defect.<sup>25</sup>.

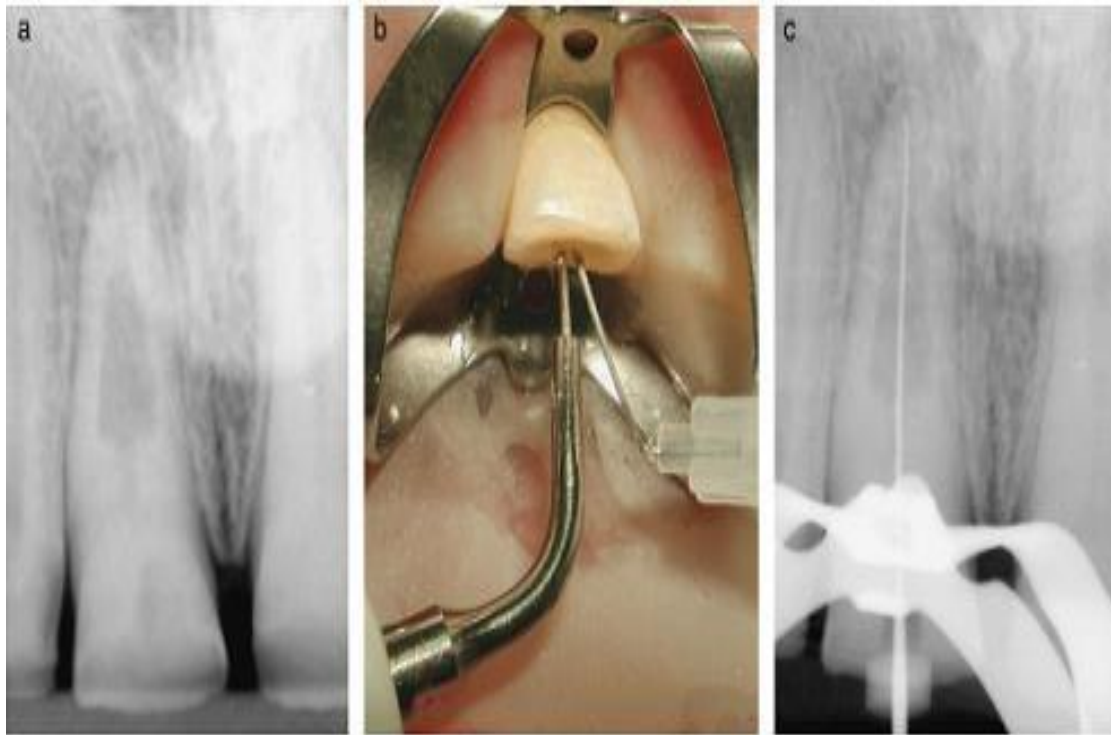
### Chemomechanical Debridement of the Root Canal

Microorganisms that linger in the canal following root canal treatment can be the primary cause of chronic apical periodontitis. Bacteria thrive in the diverse morphology of root canals. Instruments and irrigants struggle to predictably penetrate the restricted areas of the canal room, despite advancements in endodontic techniques.

Ultrasonic devices have been shown to enhance the clearance of necrotic debris and biofilms from inaccessible parts of the root canal as used to agitate the irrigant<sup>26</sup>. After mechanical preparing, ultrasonic activation of irrigants decreases the bacterial load within the root canal.

The complexity of internal root resorption lesions, chemomechanical debridement, and ultrasonic triggering of irrigants are all important aspects of internal root resorption defect disinfection<sup>26</sup>.

Chemomechanical root canal debridement fails to reliably remove bacteria from the root canal system<sup>26</sup>. (Fig.1.15)



**Fig.1.15**

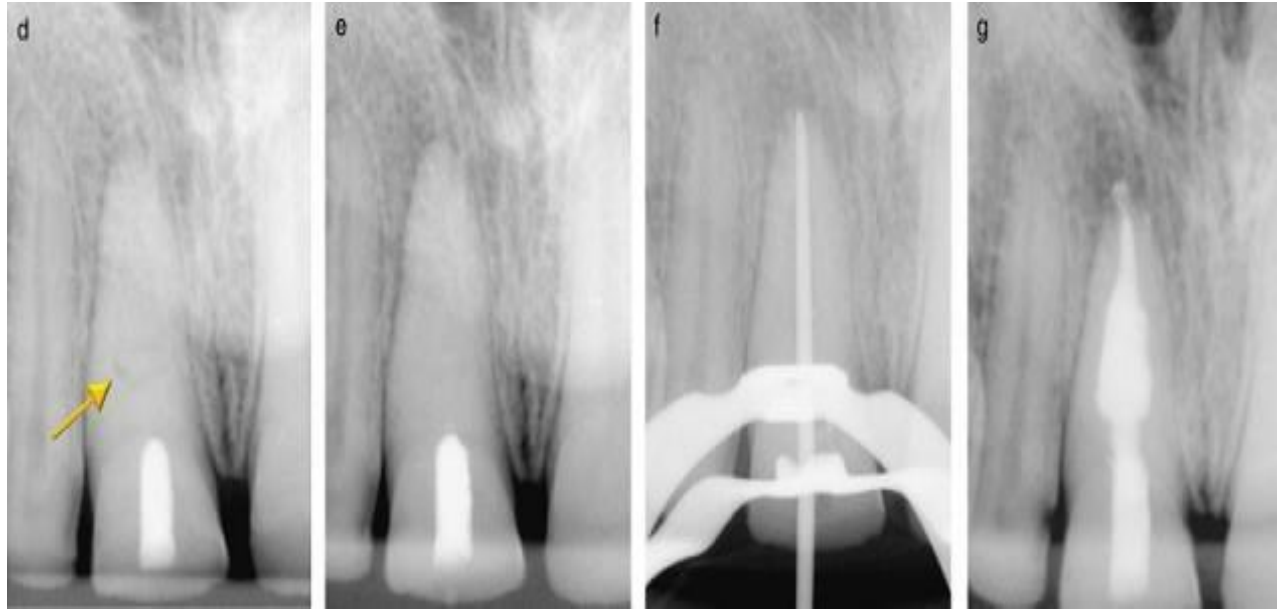
. To boost disinfection of the inaccessible root resorption defect, an intracanal antibacterial medicament should be used. Calcium hydroxide is an antibacterial substance that has been proven to successfully eliminate bacteria that have survived chemomechanical instrumentation.

As calcium hydroxide is used with sodium hypochlorite to clear organic material from the root canal, it has been found to have a synergistic effect. Nonetheless, due to its poor solubility and inactivation by dentin, tissue fluids, and organic matter, calcium hydroxide has been seen in some case studies to be unable to kill bacteria in repercussions.<sup>26</sup>

Internal inflammatory root resorption, in a patient with dentinogenesis imperfecta is at mid root level. The root canal is necrotic, and the radiograph shows a slight apical lesion. In a tooth with internal inflammatory root resorption, ultrasound and sodium hypochlorite irrigation is used simultaneously.<sup>27</sup>

### **Obturation of the Root Canal**

Complete disinfection of the root canal system is the ultimate goal of the therapy. This is followed by obturation of the disinfected canal with an appropriate root-filling material to prevent it from reinfection. Because of the complex anatomy of the defect, the obturating material should be flowable to seal the defect. Guttapercha is the material of choice as a obturating material<sup>28</sup> (Fig.1.16).

**Fig.1.16**

The result according to study is that the thermoplastic gutta-percha techniques were significantly better in filling artificial resorptive cavities than Thermafil, Soft-Core core systems, and cold lateral condensation (CLC)<sup>28</sup>. The root canal and the defect was filled with calcium hydroxide. The arrow points to a region where calcium hydroxide was not fully filled, presumably due to leftover tissue left over from the resorption. The chemomechanical instrumentation, which included irrigation with sodium hypochlorite and the use of ultrasound, was replicated at the second appointment. In the resorption region, calcium hydroxide packing no longer reveals empty spaces. At the conclusion of the third appointment, a master cone radiograph of the tooth was taken. The root canal and internal resorption have been filled with gutta-percha and sealed using warm vertical condensation.<sup>28</sup>.

### **Surgical repair**

Indications for surgical repair

Surgical flap

Root resection

Intentional replantation

### **Surgical flap**

In situations when the root wall has been perforated, mineral trioxide aggregate (MTA) should be considered the material of choice to seal the perforation<sup>29</sup>. Biocompatibility of MTA makes it a gold standard material in effectively treating furcation perforations and lateral root perforations. Periradicular tissues accept this material and helps in complete regeneration of the periodontium<sup>30</sup> (Fig.1.17).



**Fig.1.17**

Recommending treatment plan is a hybrid technique in which apical third area is sealed with guttapercha and the remainder of the canal is filled with MTA with the lesion. When internal resorption has rendered the tooth untreatable or unrestorable, extraction is the only treatment option<sup>30</sup>.

### **Root resection**

If the resorbed area is located in the radicular third, root may be resected coronal to the defect and apical segment is removed afterwards<sup>30</sup>.

### **Intentional replantation**

If the perforating resorption with minimal root damage occurs in an inaccessible area, intentional replantation may be considered<sup>30</sup>.

## **9. Conclusion**

For teeth afflicted with internal root resorption, root canal therapy is the only treatment option. The resorptive injury induced by an inflamed pulp and clastic precursor cells. The blood vessels have these clastic cells. As a result, traditional root canal surgery can easily manage the mechanism of internal root resorption by cutting the blood flow to the resorbing tissues. To avoid over-weakening of the residual root structures and root perforations, early identification and a proper differential diagnosis are critical for effective control of the outcome of internal resorption. As a result, the clinician can rely heavily on radiographs to diagnose this pathology during regular oral exams. While the introduction of CBCT has provided an effective adjunctive diagnostic method for distinguishing between ECR and internal root resorption.

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