

## Root canal sealer extrusion: When to use surgical and non-surgical treatment approach

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### Abstract

Extrusion of root canal sealers may cause irritation to the periapical tissues and lead to pain, swelling and paresthesia. An extensive search of the endodontic literature was made to identify publications related to extrusion of root canal sealer and the management in surgical and non-surgical approach. This review aims to gain an understanding of the management of root canal sealer extrusion. In conclusion, cases of root canal sealer extrusion can be treated both surgical and non-surgical. Surgical treatment should be decided on only in association with clinical symptoms or with radiographic evidence of increasing periapical lesion. Wait and see and anti-inflammatory treatment considered to be the best choice in treating extruded root canal sealer with no apical symptoms.

**Keywords:** Extrusion; Sealer; Surgical; Non-Surgical

### 1 Introduction

Root canal treatment is indicated in teeth with infections that have reached the pulp chamber, both vital and non-vital, and are irreversible. Basically, root canal treatment aims to clean and eliminate bacteria and their metabolic products, remove necrotic tissue, assist the healing process of periapical tissues and prevent recurrent infections of the teeth and periapical tissues (1). Root canal treatment consists of three main stages known as the endodontic triad, namely biomechanical preparation which includes cleaning and shaping, disinfection which includes irrigation and sterilization, and ended with adequate root canal filling (obturation). The success of root canal treatment is largely determined by the operator's ability to carry out these three stages properly, so as to clean the root canal system, eliminate the source of infection in the teeth and prevent the possibility of re-infection of the teeth. Efforts that can be made to prevent the possibility of reinfection of teeth after root canal treatment is to accommodate hermetic root canal filling to prevent seepage of fluid into the root canal which is feared to bring new infectious agents into the root canal from the coronal direction (2).

Ideally, the filling material should reach the apex of the root, without extending into the periapical tissues or other neighboring structures. Occasionally, however, excessive instrumentation of the root canal with manual or rotary instruments may allow extrusion of sealers, dressing agents, irrigation solutions and microorganisms out of the tooth, into the anatomic structures and surrounding periapical tissues. Extrusion of relatively small quantities of material is generally well tolerated by the periradicular tissues, however clinical symptoms such as pain, lip swelling, dysesthesia, paresthesia, hypoesthesia and anesthesia may occur, especially when the extruded filling material is in close proximity to or in close contact with nerve structures. Clinical symptoms may also occur due to the neurotoxic effects used, mechanical trauma from excessive instrumentation and pressure from the presence of fillers and sealers in the inferior alveolar canal. These things can initiate an inflammatory process that causes therapy failure and requires patients to undergo additional therapy to overcome it (3).

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### **1.1 Extrusion of Root Canal Sealer**

Root canal obturation is one of the most important factors that contribute the success rate of endodontic therapy. Ideally, root canal filling material is confined to the root canal space. The presence of filling material outside the apical radiograph is described as overfilling which causes extrusion of the root canal filling material through the apical foramen (2). Root canal Sealer that extrude into sinuses In the maxilla can cause symptoms similar to maxillary sinusitis, including aspergillosis infection, paresthesias and nerve complications. In most cases, Aspergillus infection is caused by root canal filling materials containing zinc oxide-eugenol (ZOE) and paraformaldehyde that accidentally entered the sinuses.

In the mandible, the main symptoms that generally appear are pain, swelling and paresthesia. Postoperative pain is thought to be related to a periapical inflammatory response and may persist from several hours to several days following endodontic therapy. Severe endodontic pain after sealer extrusion requires early diagnosis and prompt management to reduce the risk of permanent nerve damage. Pain can appear spontaneously, intermittently, or permanently. In addition, eating, talking, cold or hot stimulation can also trigger pain. Patients may also complain of a burning sensation, a feeling of being stuck with a needle, or pressure on the teeth. Pain may be accompanied by signs of local inflammation with tenderness on percussion, pain on palpation of the buccal alveolar process or a combination of signs of mechanical trauma and inflammation of the inferior dental nerve with pain or numbness of the lower lip. Paraesthesia can be caused by over-instrumentation, by pressure of endodontic material in the mandibular canal after perforation, by neurotoxic effects, reversible and irreversible blockage of nerve conduction, or by changes in nerve membrane potential (4).

An acute inflammatory response will develop in the periradicular tissues as a result of additional disturbance of the root canal system, which may be of mechanical, chemical, or microbial origin. Mechanical and chemical injuries are usually associated with over-instrumentation, apical extrusion of irrigators or sealers, etc. Root canal sealers with various formulas have been developed over time. Research shows that all root canal sealers are neurotoxic to some degree, and chemical neurotoxicity results from the extruded constituents (4).

There are many factors that can increase the risk of extrusion of root canal filling materials, including excessive instrumentation, errors in calculating working length, anatomical complexity of the root canal system, excessive amount of sealer, excessive condensation, hydrostatic pressure, use of lentulo spirals, unspecified canal apex. ripening or root tip resorption. Most case reports indicate that sealer extrusion, especially due to excessive instrumentation, is more likely to occur in premolars and molars (2,4)

### **1.2 Radiographic findings**

Extrusion of root canal filling material radiographically appears as radiopacity along the root canal past the tip of the root and extends into the periapical or periradicular tissues. Ideally, the filling material should be confined to the intraradicular space. Studies have shown that the highest success rate of endodontic treatment is observed in teeth with root canal filling ending at 0-2 mm before the tooth apex on radiographic images (5).

### **1.3 Tissue response due to Sealer Extrusion**

An ideal endodontic sealer must possess physicochemical properties, antimicrobial activity and biocompatibility, due to its contact with the periapical tissues. Sealer extrusion may occur in several clinical situations, such as in the case of root tip resorption. In this case, the material should not interfere and instead assist in the repair process, including bone remodeling. Sealer that penetrates the periapical tissue will act as a foreign body and the tissue response depends on the composition of the extruded sealer (6).

Mechanical and chemical injuries associated with excessive instrumentation, extrusion of irritants in the apical tissues or extrusion of sealers together with microbial contamination of the root canal system, generally result in an acute or chronic inflammatory response in the periradicular tissues. Filling material extruded into the periapical area causes an immune reaction against foreign bodies in the connective tissue. The presence of microbial infection is a major cause of endodontic failure, but reactions to foreign bodies can exacerbate and sustain the disease and symptoms. Extruded sealers generally dissolve in periapical tissue fluid and are then phagocytosed or coated by fibrous tissue. Fine particles and exudate elicit a local tissue response, characterized by the presence of macrophages and multinucleated giant cells and well-encapsulated sealer particles by fibrous tissue. As a result, over time, macrophages were able to completely clear the sealer from the periapical area as symptoms subsided. However, these results are highly dependent on the composition of the sealer and the amount of extrusion. Histological examination revealed that a marked inflammatory response may occur in the periapical tissues immediately after extrusion of the sealer (3,7).

In the case of extruded sealer penetrating into the maxillary sinus, it is believed that the extruded sealer does not reside in a specific area of the antrum. The sealer will be perceived by the body as a foreign body and then the ciliated mucosal cells tend to move it towards the natural orifice, which can then become a blockage in the orifice. Static secretions create anaerobic conditions that favor the growth of *Aspergillus* spores and allow for aspergillosis to occur at the same time. However, very small particles can be transported by the cilia of the epithelium lining the maxillary sinuses, mix in the mucous fluid against gravity, up the nasal walls of the sinuses, and out into the nose through the ostium (4).

#### 1.4 Treatment for the extrusion of Root Canal Sealer

##### 1.4.1 Non-surgical approach

The current pathophysiology mechanism of chronic cough is known as cough hypersensitivity syndrome. This theory is based on the finding that a large proportion of patients develop a cough after low-level temperature, chemical, or mechanical exposure. CHS is considered a neuropathological mechanism that affects the peripheral and central nervous system. (4,21) The cough reflex in humans has 2 types of afferent pathways. The first afferent pathway is induced by mechanosensory stimuli, which are transmitted via myelinated nerve fibers. The second pathway is the chemosensory pathway, formed by a group of C nerve fibers without myelin and transmitting the same as in tissue injury-induced pain which is controlled by cation channel receptors, especially transient receptor potential vanilloid 1 (TRPV1) and TRPA1 or irritant sensors. (7,21) In RCC there is an increase in nerves with TRPV-1 which causes a cough hypersensitivity reflex due to being more sensitive to exposure to certain stimuli. This is similar to hyperalgesia in chronic neuropathic pain. (3)

##### 1.4.2 Surgical approach

The cough reflex mechanism is initiated by stimulation and activation of the airway sensory nerves due to inflammatory substances such as local substance, inhalation, or aspiration which causes an increase in intracellular calcium which opens the pannexin channels and releases ATP to activate the P2X3 channels in the sensory nerves. This event causes cell depolarization which can stimulate the opening of NaV and generate action potentials that are carried via the vagal nerve to the central nervous system. (4) Inflammatory mediators in the airways play a role in TRPV1 activity, which is a sensor molecule that detects various noxious environmental stimuli. The TRPV-1 ion channel which is a chemo sensor, is upregulated in chronic cough. Capsaicin is a direct agonist of the TRPV-1 receptor, which can increase the sensation of wanting to cough. Patients with hypersensitive cough experience an increased response to the inhalation of capsaicin in the cuneiform nucleus area. In patients with chronic cough, it is easier to experience coughing along with an increase in the intensity of the stimulus. (5,23)

##### 1.4.3 Prevention of root canal sealer extrusion

Carrying out each endodontic stage carefully can prevent overfilling during endodontic treatment. This includes calculating the working length accurately, using appropriate intracanal devices, maintaining resistance forms during root canal preparation, not applying excessive pressure into the root canal during the preparation and filling stages of the root canal material, and using sealer only as needed. In addition, the sealer used must have minimal toxicity to prevent excessive damage during overfilling. The use of fillers containing formaldehyde or paraformaldehyde should be avoided as these materials can have a detrimental effect on the patient. Endodontic treatment of the distal roots of the maxillary and mandibular first molars must be carried out with caution because of the anatomical shape of the root apex adjacent to the mandibular canal. Operators must also be careful in using root canal filling materials with paste preparations because they are more difficult to control (10).

According to the American Association of Endodontics, there are several things you can do to prevent material overfilling, namely (11):

- When choosing a filling technique, it is important to pay attention to the adjacent anatomical structures and the degree of patency of the root. Also pay attention to the viscosity of the obturation material and operator confidence.
- Maintain apical patency by limiting the apical preparation to #10 or #15 sized files.
- Using a thermoplastic obturation technique to prevent excess pressure to the periapical area.

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## 2 Conclusion

The determination in choosing treatment modalities for treating extruded root canal sealer should be based on clinical symptoms and radiographic findings. Surgical approach recommended in some cases of prolonged pain and swelling or

pain and paresthesias. Non-surgical treatment approach which consist of observation and retreatment of the treated tooth can be done regarding to toxicity of sealer component material.

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## Compliance with ethical standards

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The author declares no conflicts of interest.

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