

Hypersensitivity Reaction Induced by d-Limonene Containing Gutta-Percha Solvent: A Case Report

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Abstract

Non-surgical endodontic retreatment is frequently indicated when initial endodontic therapy fails. To facilitate the removal of gutta-percha, chemical solvents are employed. Although these solvents provide significant benefits, improper application can lead to adverse events. This article presents a case report of angioedema resulting from periapical seepage of orange oil and discusses the preventive measures and management protocols for such incidents within the dental practice.

Keywords: Gutta-percha, Gutta-percha solvent, Non-surgical root canal treatment.

INTRODUCTION

Non-surgical endodontic retreatment is often the preferred course of action for failed root canal therapy.^[1,2] Gutta-percha (GP) has been the most frequently used root canal obturating material which is simple enough to remove in case of endodontic failure. There are several methods for GP removal: Thermal, mechanical, and chemical solvents.^[3-5]

Chemical solvents such as chloroform, halothane, xylene, eucalyptol, orange oil, and rectified turpentine are used to soften and reduce the resistance of GP for removal during endodontic retreatment procedures.^[6] Chloroform and eucalyptol have been used as solvents since 1850.^[7-10] Chloroform, although effective in softening GP and reducing enterococcus faecalis to non-cultivable levels, is classified as a Group 2B carcinogen by the International Agency for Research of Cancer, indicating sufficient evidence of carcinogenicity in animals but inadequate evidence in humans.^[6]

A study done by Ribeiro *et al.*, in 2007, revealed that chloroform and eucalyptol are strongly cytotoxic.^[7] Another study by de Carvalho Maciel and Zaccaro Scelza in 2006 to evaluate the cytotoxicity of orange oil, eucalyptol, and chloroform stated that orange oil was less cytotoxic than eucalyptol and chloroform.^[11]

Orange oil comprises limonene, aliphatic hydrocarbon alcohols, and aldehydes such as octanal. It is less cytotoxic and has low solubility in water which makes it a safer alternative

when used with caution. It is traditionally used for cleaning and removing cements, pastes, and impression materials and is widely recommended for endodontic retreatment due to its safety and efficacy.^[12] Pecora *et al.*, in 2003, reported that orange oil-softened GP with similar results to xylol and suggested it as an alternative.

The evidence of accidents/incidents with different solvents in the literature is rare and that with orange oil is almost absent. The purpose of this article is to highlight a case report of one such procedural accident as a consequence of using GP solvent for the removal of GP.^[6]

CASE REPORT

A 28-year-old male patient came to our department of conservative dentistry and endodontics of the dental college and hospital with the chief complaint of pain, fever, and huge swelling in the left maxillary anterior teeth region from past 24 h. The pain was dull and continuous in nature. From patient, the contact was made to the clinic from where the patient was referred to

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Received: 10-07-2024; **Accepted:** 09-08-2024; **Published:** 30-08-2024

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How to cite this article: Das U, Gupta P, Saha KK, Murmu LB, Das AK, Mondal P. Hypersensitivity Reaction Induced by d-Limonene Containing Gutta-Percha Solvent: A Case Report. J Res Adv Dent 2024;15(6):1-4.

Access this article online

Website:
www.jrad.co.in

DOI:
<https://doi.org/10.53064/jrad.2024.15.6.573>



Figure 1: (a) Swelling of upper lip and left eye on the 1st day, (b) 2nd day image of the patient, and (c) cone-beam computed tomography showing lesion involving 21, 22



Figure 2: (a) 4th day image of the patient with lip swelling, (b) image of the labial mucosa after healing, and (c) 10th day image of a patient showing complete resolution of the lip swelling

our dental college and hospital. The clinician gave a history of attempted retreatment of previous endodontically treated teeth no #21 and #22. Access was made through the existing crown as the patient was not willing for removal and the retreatment was initiated in the private dental clinic. The clinician mentioned that the GP solvent composed of orange oil was used with cotton to aid in the removal of the GP using the hand files. The patient complained of irritation immediately after the application of GP solvent and the procedure was stopped immediately. The canal was adequately irrigated with copious amount of normal saline and symptomatic relief was given to the patient. The patient was, then, recalled for the next appointment but the same day within 5–6 h of initial treatment, the patient reported with the profuse swelling of the upper lip along with the rise in body temperature and pain. Then, the dentist of the private dental clinic immediately removed the temporary restoration, canals were irrigated with normal saline, then closed dressing was given, and the patient got referred to our dental college and hospital.

On arrival to our department, it was noticed that there was profuse swelling of the upper lip and obliteration of the nasolabial fold along with swelling of the left eyelid, as shown in (Figure 1a and day 2 image in b). Rise in patient's body temperature (101°F) with the presence of moderate pain was also noticed. The patient was immediately taken to the department of oral and maxillofacial surgery where the swelling was diagnosed with angioneurotic edema due to an allergic reaction probably caused by orange oil. Consultation was also taken from the department of oral medicine and radiology. Serological tests, electrocardiography, cone-beam computed tomography (Figure 1c), and echocardiogram were done. The

Table 1: Extrusion Injuries

Symptoms	Grade of injury		
	Mild	Moderate	Severe
Pain (visual pain score)	0–3	4–6	7+
Swelling (%)	<30	30–50	>50
Ecchymosis	Localized	Diffuse	Diffuse
Other	No ulceration	Intraoral ulceration	Intraoral ulceration
			Intraoral necrosis
			Airway compromised
			Neurovascular deficit
Pathway	GDP/endodontist	OMFS	OMFS

GDP: General dental practitioners, OMFS: Oral and maxillofacial surgery

patient was put on antibiotics (cefuroxime 500 mg BD) for 5 days, corticosteroids 100 mg stat, analgesics (aceclofenac 100 mg, acetaminophen 325 mg, and serratiopeptidase 15 mg BD) for 5 days, antihistaminics (levocetirizine 5 mg OD) for 5 days, and pantoprazole (40 mg OD) for 5 days. After 4 days, there was an improvement in the patient's condition, as shown in the (Figure 2a), and swelling was reduced. On the 10th day recall visit, the patient was without any symptoms, the swelling was completely gone, and the labial mucosa also showed signs of healing, as shown in (Figure 2b and c).

DISCUSSION

Non-surgical endodontic retreatment has become the preferred approach over periradicular surgery for managing

Table 2: Categories of GP Solvent

Time interval after injury	Mild	Moderate	Severe
	Mx by GDP/endodontist	Refer to OMFS/hospital	Refer to OMFS/hospital
Immediate treatment (treatment within 24 h following injury)	• Irrigation with saline/sterile water • Analgesia (OTC) • Non-steroidal anti-inflammatory • Cold compress • Investigations to identify perforation or root pathology • Radiographs IOPA or dental panoramic tomography	• Treatment as for mild injury. • Analgesia (opioids) • Ref to OMFS	• Treatment as for moderate injury • IV antibiotics • IV steroids • Investigations MRI, CT
Early treatment within the 1 st week following immediate treatment	• Warm towel compress-regular review • Extraction of tooth (if required)	• Treatment as for mild injury • Antibiotics if there is any evidence of infection • Debridement of necrotic tissue	• Treatment as for moderate injury • Incision and drainage of any collection • Definitive airway (tracheostomy) if airway if compromised (emergency case)
Late treatment	• Complete RCT with a different irrigant	• Complete RCT with a different irrigant • Lipodystrophy-fillers/implants/ Coleman fat transfer • Reviewed by OMFS	• Lipodystrophy-Fillers/Implants/Coleman fat transfer • Medical management of neuropathic pain • Damage to motor nerves requiring advice from speech and language therapy, • Physiotherapy due to lip incompetence and poor oral seal Surgery

MRI: Magnetic resonance imaging, CT: Computed tomography, GDP: General dental practitioners, IV: Intravenous IOPA: Intraoral periapical radiograph, OMFS: Oral and Maxillofacial Surgery, RCT: Root canal treatment

cases of failed root canal treatments (RCTs).^[1-3,13] Ensuring the complete removal of GP and sealer is crucial for the thorough cleaning, shaping, and refilling of the root canal system. However, during non-surgical endodontic procedures, the mechanical removal of root canal obturating materials poses risks such as root perforation, canal straightening, or alteration of the original canal morphology. The application of organic solvents and essential oils has been projected to facilitate the retrieval of obturating materials from the canal by reducing their resistance.^[12] Nonetheless, clinicians must exercise caution regarding the selection of removal techniques and solvents. All solvents are known to be toxic to the periapical tissues and should be used with caution.^[6,13]

Selecting an optimal solvent for endodontic retreatment necessitates balancing clinical safety, tissue toxicity and aggressiveness, and the solvent's chemical dissolution capacity. The ideal endodontic solvent requires the following properties: high solvent effect, low surface tension, low cytotoxicity, absence of carcinogenic effects, ease of use, quick effect, and long shelf-life.^[6-9,12,13]

It is important to recognize that solvents can be aggressive towards periapical tissues, as observed in this case. The apically directed pressure of hand files to facilitate solvent penetration may contribute to apically extruded debris and solvent, potentially causing irritation, and disrupting healing^[6,4,13] and provoking allergic or hypersensitivity reactions.

Despite careful consideration during re-RCT, if faced with a suspected GP solvent-related extrusion injury, a thorough clinical and radiological assessment is recommended to determine the degree and extent of the injury.

Farook *et al.* categorize extrusion injuries as mild, moderate, and severe according to patient's signs and symptoms (Table 1). Each category has been subdivided into immediate, early, and late management to optimize the care provided.^[14]

The guideline for the management of extrusion injuries has divided treatment in two modalities (Table 2);

- Relative to severity of injury
- Relative to the time of injury and includes immediate, early, and late treatment.

In this case, a type IV hypersensitivity reaction, also known as delayed-type hypersensitivity, was noted. The condition matches with a moderate type of injury according to Farook *et al.*^[6,15] that treatment was done accordingly and the patient's condition got improved.

Precautions to be considered for GP solvent extrusion accidents:

- Proper access preparation
- Good working length control if half of the GP is removed
- It should not be used in open apex cases
- The use of solvent is to be minimized as much as possible
- Rubber dam application is mandatory to avoid contact of the solvent with the oral mucosa
- Solvents should not be directly injected into the canal. Instead, it should be applied on a small cotton pellet and then placed in the canal using a spreader or file.

Recently, soft-tissue lasers, that is, Nd: YAG laser have shown to be capable of softening the GP. Nd: YAG laser at lower setting (100 mj 15 Hz, 1.5 w) produces fairly clean root canals, but incomplete removal from dentinal walls. At increased power levels (100 mj, 20Hz, 2 w), the laser seems to be more efficient in cleaning the canal walls.^[14]

CONCLUSION

The extrusion of d-limonene during retreatment cases into the periradicular tissues is a rare occurrence; nevertheless, the consequence of which can be potentially serious and can have significant morbidity to the patient. Based on the presented case report, special attention must be drawn to the potential risks both short- and long-term associated with the use of d-limonene-containing GP solvents for retreatment. Thus, it is important to carry out an effective technique to avoid complications. In the event of accidental extrusion of d-limonene containing GP solvent, treatment guidelines should be applied according to the magnitude of each case.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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