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REVIEW ARTICLE

ACCIDENTAL INJECTION OF FORMALIN INSTEAD OF LOCAL ANAESTHETIC DURING DENTAL PROCEDURES: A COMPREHENSIVE REVIEW

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ABSTRACT

Accidental intraoral injection of formalin instead of local anaesthetic represents a rare but significant iatrogenic emergency in dental practice. Although formalin is an essential fixative for histopathology, its highly caustic nature makes it dangerous in the operatory environment when stored improperly. The incident typically occurs when colorless solutions are kept in unlabeled or repurposed local anaesthetic vials, a practice still prevalent in some clinical settings in India. Once injected, formalin produces immediate coagulative necrosis, severe inflammation, oxidative stress, and potential systemic toxicity. Published literature shows that all reported cases of such incidents originate from India, highlighting unique workflow and storage challenges in these settings. This review provides an in-depth analysis of the chemical properties of neutral buffered formalin (NBF), mechanisms of fixation, tissue injury patterns, clinical presentation, evidence-based management strategies, prevention, and medico-legal implications. Recommendations emphasize strict labelling, proper storage, clinician supervision, and staff training to eliminate the risk of such preventable events.

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INTRODUCTION

Formalin, an aqueous solution of formaldehyde gas (usually 37–40% w/v), is one of the most widely used chemical fixatives in pathology laboratories due to its ability to preserve cellular and tissue integrity for histopathological evaluation (1). In dental practice, biopsy specimens are almost universally stored in 10% neutral buffered formalin (NBF) because its buffering capacity prevents acidification and pigment artefacts (2). Unfortunately, formalin's presence in the clinical environment introduces the possibility of mix-ups with other colorless fluids, most notably local anaesthetic (LA) solutions. This risk is magnified in clinics where LA vials are reused for storing biopsy specimens, a practice documented extensively in Indian case reports (3). Accidental injection of formalin results in immediate and severe tissue damage due to its protein-denaturing and crosslinking properties, making early recognition and prompt intervention essential. The rarity of such events means many clinicians may not recognize the early signs of formalin-induced injury. This review addresses the need for awareness by consolidating available scientific, clinical, and epidemiological data.

Composition and Preparation of Neutral Buffered Formalin (NBF)

Chemical Composition: NBF is prepared by diluting 40% formaldehyde solution to a final concentration of approximately 4% formaldehyde, commonly referred to as 10% formalin (1). Its essential components are:

- Formaldehyde (4%) — active fixative
- Phosphate buffer (pH 6.9–7.1) — prevents acidification
- Methanol (10–15%) — inhibits polymerisation
- Distilled water

The phosphate buffer maintains neutrality because unbuffered formalin tends to oxidise to formic acid, lowering the pH, which can distort tissues and produce acid formaldehyde hematin pigment (4).

Preparation of Phosphate-Buffered Saline: PBS is prepared using sodium chloride, potassium chloride, disodium hydrogen phosphate, and potassium dihydrogen phosphate in distilled water, and serves as the diluent to achieve the correct formaldehyde concentration (2).

Importance of Buffering: Buffered solutions prevent artefactual pigment deposition, maintain consistent fixation quality, and prevent progressive acidification, which can occur when formalin is stored for extended periods or exposed to air (4).

Mechanism of Formalin Fixation: Formaldehyde reacts with amino groups—primarily those of lysine residues—to form covalent crosslinks known as methylene bridges (1). These bridges:

- Stabilize protein structure
- Preserve tissue morphology

- Prevent autolysis
- Inhibit bacterial decomposition

Although this process is advantageous for preserving biopsy material, it is catastrophic when occurring within living tissues. In vivo, formalin induces coagulative necrosis, denatures proteins, disrupts cellular membranes, and activates inflammatory cascades, leading to severe tissue injury (5).

Limitations and Storage Issues Associated with Formalin: Despite being an excellent fixative, formalin has several limitations:

Limited Penetration: Formalin penetrates tissues at approximately 1 mm per hour, reaching a depth of only 3–4 mm (2). This property necessitates thin specimen slicing.

Impact on Immunohistochemistry: Prolonged fixation masks antigen sites, reducing the sensitivity of immunohistochemical staining (4).

Alteration of DNA: Extended exposure crosslinks nucleic acids, complicating PCR-based applications and genetic analyses (4).

pH Instability: Over time, particularly when stored in reused vials or non-airtight containers, formalin oxidises to formic acid, causing tissue artefacts (4).

Storage Duration: NBF should not be stored for more than 3 months, as buffer degradation leads to acidification (2).
These limitations highlight the need for careful chemical management in dental clinics.

Epidemiology of Formalin Accidents in Dentistry: All known published cases of accidental intraoral formalin injection have been documented in India (3,6–9). A review of eight well-reported cases shows:

Patients ranged from 8 to 52 years

Injection sites: inferior alveolar, posterior superior alveolar, infraorbital, mental, and buccal regions.

Healing time varied from one week to one year depending on severity

Most incidents were attributed to reuse of empty LA vials for storing biopsy samples or chemicals (3–9)

The pattern indicates that such errors are largely preventable and relate to workflow design, storage practices, and staff training.

Pathogenesis of Tissue Injury Following Formalin Injection

Cellular Injury

- Formalin triggers extensive cellular damage through:
- Protein denaturation
- Mitochondrial toxicity
- Generation of reactive oxygen species (ROS)
- Lipid peroxidation
- Disruption of intracellular signaling
- This results in rapid cell death and tissue fixation at the site of injection (5).

Vascular Effects

- When formalin enters vascular tissues:
- It causes acute hemolysis due to erythrocyte membrane damage
- Leads to metabolic acidosis caused by formation of formic acid
- May result in hemoglobinuria, contributing to renal stress (4)

Tissue-Level Pathology

- Microscopic features include:
- Coagulative necrosis
- Intense acute inflammatory response
- Microvascular thrombosis
- Sloughing of devitalized tissue
- Subsequent fibrosis
- These changes explain the severe pain, swelling, and delayed healing seen clinically.

Clinical Presentation

Within the First 24 Hours

Patients typically experience:

- Immediate sharp, burning pain at injection site (6)
- Rapid-onset swelling, progressively enlarging
- Tightness, discomfort, and inflammatory oedema
- Diffusion of swelling across adjacent tissues

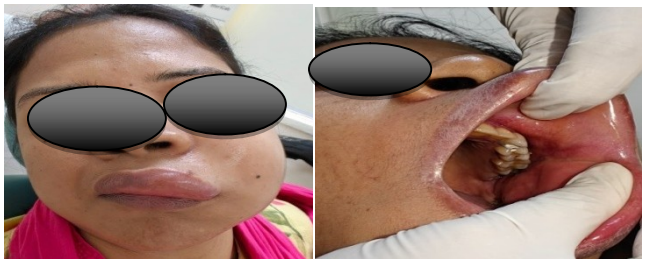

Figure 1. Extra oral photograph showing swelling
Figure 2. Intra oral photograph showing accidental injection site

After 24 Hours

If untreated:

- Oedema increases markedly (6)
- Severe pain persists
- Necrotic slough appears within 48 hours (7)
- Widespread ulceration and purulent discharge may occur
- Functional limitations such as trismus, dysphagia, or impaired mastication develop
- The clinical severity depends on both the amount and concentration of formalin injected.

Management Protocol: Management must begin immediately upon recognition.

Immediate Management

- IV Dexamethasone 8 mg to reduce inflammatory oedema (1,7)
- High-dose broad-spectrum antibiotics, e.g., Amoxicillin 1 g (7)
- Analgesic support
- Incision and drainage with placement of a tube drain
- Repeated saline irrigation
- Loose closure to allow drainage

Continued Management (1–2 weeks)

- Oral antibiotics for 7 days
- Analgesics and proteolytic enzymes
- Oral corticosteroids tapered over 2 weeks
- Debridement if necrotic tissue sloughs
- Reconstruction with collagen membranes for deeper defects (6)
- Early intervention significantly reduces tissue loss and accelerates healing.

Figure 2. Extra oral photograph showing reducedswelling and patient is in healing phase after 10 days therapy.

Prevention: Preventive strategies include:

- Avoiding reuse of LA vials for chemicals or biopsy specimens (3)
- Proper labelling of all solutions
- Cartridge-based LA systems instead of manually filled syringes
- Ensuring LA is loaded only by the dentist or trained assistants
- Routine verification of solution identity prior to injection (7)
- Dental assistant certification and training programs
- Such safeguards can eliminate nearly all documented risk factors.

Medico-Legal Considerations

- Accidental formalin injection constitutes professional negligence. Medico-legal recommendations include:
- Accurate documentation of the event and treatment (1)
- Disclosure to the patient and family
- Compliance with standard protocols
- Maintaining properly labelled, segregated chemical storage
- Clinics must demonstrate that reasonable preventive measures were in place.

CONCLUSION

Accidental formalin injection is a rare but entirely preventable iatrogenic emergency. By understanding formalin chemistry, injury mechanisms, and evidence-based management, dental professionals can minimize morbidity and avoid medico-legal consequences. Strict adherence to safe storage, labelling, and staff training is essential to eliminate such avoidable incidents from clinical practice.

REFERENCES

Saujanya KP, Ali FM, Japati S, Srivalli L. Dental negligence: case reports of accidental formalin injection and chemical burn caused by sodium hypochlorite. *J Dent Orofac Res.* 2014; 10:34-5.

Dandriyal R, Giri KY, Alam S, Singh AP. Accidental intraoral formalin injection: A rare case report. *Clin Pract.* 2014;4:60-3.

Chakraborthy S, Veeresh MR. Formalin: a rare suicidal poison. IOSR JDMS. 2015;14:24-6.

Yazdi Z, Sadeghniiat-Haghighi K, Aminian O. Hemolytic anemia as an outcome of occupational exposure to formalin: a case report. *Iran J Toxicol.* 2012;6:668-71.

Lian CB, Ngeow WC. Formalin mishandling during wisdom tooth surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1998;86:630-1.

Swami PC, Raval R, Kaur M, Kaur J. Accidental intraoral injection of formalin during extraction: case report. *Br J Oral Maxillofac Surg.* 2016;54:351-2.

Arakeri GI, Brennan PA. Inadvertent injection of formalin mistaken for local anaesthetic agent. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2012;113:581-2.

Bector A, Virk PS, Arakeri G. Chemical facial cellulitis due to formalin injection into oral tissue. *Clin Pract.* 2015; 5:113-5.

Gupta A, Adhikari HD, Paul ML. Management of a case with accidental injection of formalin mistaken for local anaesthetic. *Indian Assoc Conserv Dent Endod.* 2016.