

Management of bur fracture in oromaxillofacial surgery: a case series and diagnostic considerations for retrieval versus retention

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Abstract

Background: Bur fracture during oral and maxillofacial surgery, although rare (0.2%–2%), presents significant clinical challenges due to potential complications such as tissue migration, infection, and damage to vital structures. Accurate localization and management of fractured burs are essential to optimize patient outcomes, with advanced imaging modalities like cone-beam computed tomography (CBCT) playing a key role in diagnosis and treatment planning. **Aim:** This case series evaluates diagnostic strategies and treatment decisions in managing bur fractures during oral and maxillofacial procedures, emphasizing the importance of imaging, clinical judgment, and tailored surgical approaches to reduce complications. **Materials and Methods:** Three cases involving bur fractures during different surgical procedures were reviewed retrospectively. Intraoperative radiographs, CBCT scans, and postoperative imaging were used to locate the fragments. Management strategies ranged from immediate surgical removal to conservative observation based on the fragment's position, stability, and proximity to vital structures. **Clinical follow-up** assessed healing and potential complications. **Results:** In the first case, intraoperative orthopantomography successfully removed a bur fragment embedded near the mandibular molar. The second case used postoperative CT imaging to locate a deep fragment in the canine pillar, which was left in place due to its stable position, with subsequent removal during a planned second surgery. The third case involved a deeply embedded fragment in the maxilla, managed conservatively after CBCT confirmed its safe, stable location. All patients remained asymptomatic during follow-up, with no signs of infection or migration. **Conclusion:** Management of bur fractures should be tailored to the individual, relying on precise imaging, preferably CBCT, to determine the fragment's position and risk level. Conservative management is appropriate when fragments are stable and away from critical structures, while surgical removal is necessary when they are easily accessible. Preventive measures, meticulous surgical techniques, and thorough documentation are vital to minimize risks and provide optimal patient care.

Keywords: Bur fracture, Cone-beam computed tomography (CBCT), Oral and maxillofacial surgery, Fragment management



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Introduction

Bur fracture during oral surgery, though relatively rare, poses a significant challenge for clinicians and potentially complicates treatment outcomes and patient safety. The prevalence of bur breakage reported in the articles varies, with estimates ranging from 0.2% to 2%, influenced by factors such as the type of procedure, the instruments used, and the operator's experience (1). The increased use of high-speed rotary instruments and repeated stress contributes to metal fatigue, making burs more likely to fracture, especially when misused or applied with excessive force. Additionally, the design and quality of burs and maintenance protocols are essential in reducing the risk of fractures. This highlights the importance of following manufacturer guidelines and performing regular equipment checks (3). Broken burs should be removed promptly before they migrate deeper into surrounding tissues (4). If the fragment remains lodged in the surgical site, it could serve as a focal point for infection, cause ongoing inflammation, or interfere with the natural healing process, potentially leading to a longer recovery or additional complications requiring further surgical intervention (5). However, extracting a deeply embedded fragment carries risks, including possible damage to nearby crucial structures like nerves, blood vessels, or adjacent teeth, and the chance of fragment migration or fracture extension during the removal process if the fragment is lodged deeply (3,6).

Therefore, deciding whether to retrieve or retain a fractured bur must be carefully considered, considering potential complications. An accurate diagnosis is essential for guiding appropriate management strategies. Advanced imaging techniques, especially cone-beam computed tomography (CBCT), have transformed the evaluation of foreign bodies in the maxillofacial region by showing the fragment's location, size, and relationship to nearby structures (2). Intraoperative radiography further improves surgical accuracy by confirming whether the fragment has been retrieved or retained, helping to minimize unnecessary tissue damage during procedures and increasing the chances of success (1). Using these diagnostic tools together enables clinicians to create personalized treatment plans that weigh the risks and benefits of removal versus retention.

This case series examines diagnostic strategies and treatment decisions in managing bur fractures during oral and maxillofacial surgery. We aim to highlight the importance of precise imaging, careful clinical judgment, and tailored surgical approaches by analyzing three distinct cases. We also seek to demonstrate how different diagnostic modalities influence treatment options and stress the need for a systematic and individualized approach to optimize patient outcomes while minimizing potential complications.

Case Presentations

Case 1:

A 47-year-old woman presented to our Maxillofacial Surgery department for the removal of the lower left third molar. During the procedure, a bur fractured,

leaving a fragment embedded in the surgical site. No significant bleeding or nerve symptoms were reported after the incident. The patient was asymptomatic aside from mild local discomfort related to the surgery. Immediately after the bur broke, an intraoperative orthopantomogram was taken to locate the fragment (figure 1). The imaging revealed a radiopaque foreign object, consistent with a bur tip, impacted in the cortical bone near the distal root of tooth 38, slightly lingual and inferior in position. Guided by the radiograph, the surgical site was explored, and the fragment was found and removed. The area was irrigated and carefully examined to ensure no residue remained. A postoperative orthopantomogram was performed after removal of the bur fragment (figure 2), showing no remaining foreign material. Standard postoperative instructions were given, including analgesics, antibiotics, chlorhexidine rinses, and a soft diet. A follow-up appointment was scheduled in 7 days to monitor healing and check for signs of infection. This case emphasizes the importance of radiographic localization of foreign bodies and the benefit of prompt surgical management. The patient tolerated the procedure well, and a normal recovery is expected.

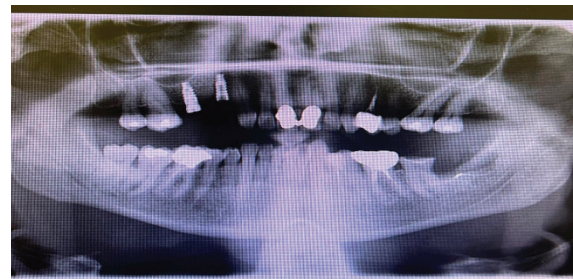


Figure 1. Intra-operative orthopantomography



Figure 2. Post-operative orthopantomography

Case 2:

A 27-year-old male presented to the Maxillofacial Surgery Department with a maxillary complex fracture following facial trauma. An open reduction and internal fixation (ORIF) with plates and screws was planned. During the procedure, a bur broke while placing the plate and screw. The bur fragment was not identified during surgery. Two conventional intraoperative radiographs were taken: anteroposterior and lateral views (Figure 3).

The bur fragment was not seen on these radiographs due to overlapping structures and limited resolution. Since a postoperative CT scan was routinely requested

to verify the correct reduction and repositioning of the fractures, it was also used to locate the fragment, which was successfully identified in the canine pillar (Figure 4), within the bone and away from any critical anatomical structures.

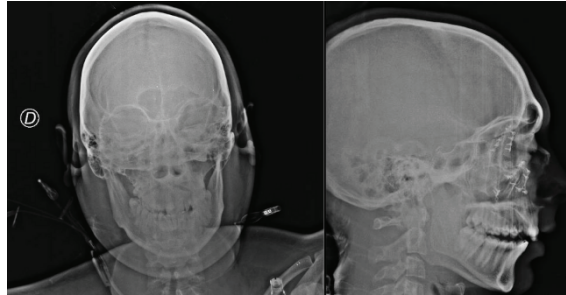


Figure 3. Intra-operative anteroposterior and lateral radiograph with no clear evidence of the broken bur



Figure 4. CT scan with evidence of the broken bur.

Based on its deep and stable position, the team decided not to remove the bur fragment, as it posed no migration risk. However, because the exact three-dimensional location of the fragment was now known and the postoperative CT indicated that a second surgery would be needed to reposition a bone fragment, the surgical team opted to remove the bur fragment during this procedure since the access would be through the same area. The fragment was successfully removed without complication. A clinical photograph of the removed bur was added to the patient's records (Figure 5).



Figure 5. The fractured bur extracted

Case 3:

A 42-year-old male was undergoing planned orthognathic surgery with the placement of a mini-screw for orthodontic anchorage. During the procedure, a bur was fractured intraoperatively while creating the hole to insert the mini-screw for the plate after Le Fort I osteotomy. The incident occurred without immediate complications; no bleeding or neurovascular injuries were observed. However, the surgery was completed successfully. A CT scan was ordered immediately post-operatively as part of standard protocol to assess the surgical outcome and, in this case, to locate the broken bur (Figure 6). The scan confirmed a metallic foreign body (bur fragment) embedded in the maxillary bone, positioned deeply and securely, with no contact to vital structures. After careful review of the CT scan and consultation with the surgical team, a decision was made to avoid surgical removal of the bur fragment. The fragment was deemed stable and non-mobile within the maxillary bone, posing no immediate or long-term risk to surrounding structures. The patient was informed about the incident and the management plan. Regular follow-up was scheduled to monitor for potential complications, including signs of infection, migration, or local discomfort. The patient remains asymptomatic at the most recent follow-up with no

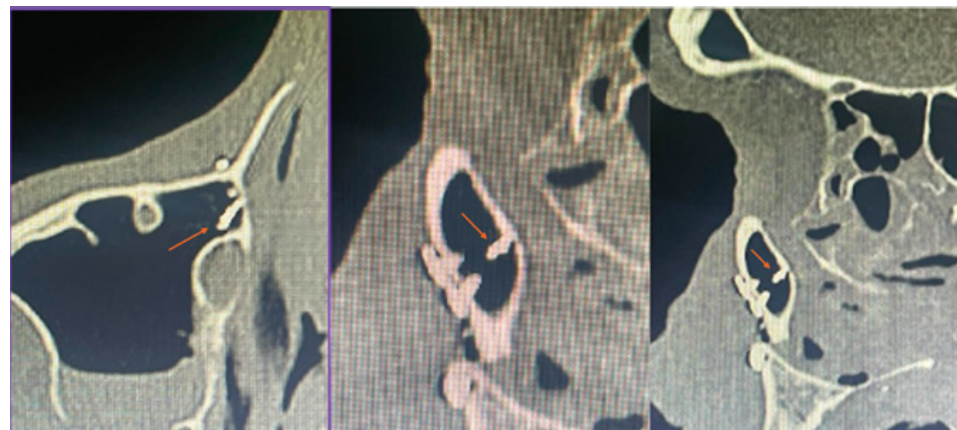


Figure 6. CT scan with evidence of the broken bur

clinical or radiographic abnormalities. When a foreign body is located in a safe, inert position and poses no risk as confirmed by radiographic assessment, conservative management with close observation can be a safe and effective approach.

Discussion

Although uncommon, a broken bur during oral and maxillofacial surgery presents clinical challenges in diagnosis and management. The three cases examined in this series demonstrate a variety of situations, from retained fragments deemed safe to leave in place to eventual surgical removal motivated by the operator during the same procedure or a subsequent one. Each case underscores the importance of proper imaging, risk-benefit assessment, and comprehensive documentation.

Initial efforts to localize broken burs using 2D intraoperative radiographs (anteroposterior and lateral) often show insufficient results due to overlapping anatomical structures and limited visibility. In contrast, a CT scan offers a superior three-dimensional view, allowing for more precise fragment localization. CT provides higher sensitivity and specificity in detecting foreign bodies than conventional radiographs, especially in the craniofacial region (7,8).

Visualizing mandibular structures is challenging with only traditional radiography because standard X-ray images often lack enough detail for accurate assessment. Cone-beam computed tomography (CBCT) becomes essential for precise imaging in these cases. CBCT offers three-dimensional views of the mandibular anatomy, allowing detailed evaluation of fractures or instrument fragments that may be present. When intraoperative CBCT is available, it provides real-time imaging that supports immediate decision-making. However, if intraoperative CBCT isn't accessible, the patient may need to be awakened to perform the imaging after surgery. CBCT is a valuable diagnostic tool, especially when assessing complex cases involving possible instrument fractures or foreign body retention within the mandible. The choice to perform imaging largely depends on whether the patient is under general anesthesia. If the patient is not anesthetized, intraoperative orthopantomography can be used to get an overall view of the mandibular region, though it lacks the detailed resolution of CBCT. Additionally, when conventional radiography is used during surgery as a diagnostic aid, it is generally more effective in detecting broken instruments or fragments within the mandible than in the maxilla. This is because the mandible's denser and more accessible bony structure provides better contrast and visualization in standard X-ray images.

What was reported above is confirmed by Patel, who states that cone beam computed tomography (CBCT) has become a valuable imaging tool in endodontics and maxillofacial diagnostics. It offers three-dimensional visualization that exceeds traditional radiography in detecting fractures, foreign objects, and complex anatomical structures. Its use is beneficial when conventional radiographs are insufficient for accurate

diagnosis, particularly in areas like the mandible, where overlapping structures can hide details (2,7).

The choice to remove or retain a broken bur fragment should be established on several factors:

- **Location:** Fragments fixed in bone or near vital structures like nerves, vessels, or sinus cavities deserve careful consideration. In two cases, fragments were left in place due to their secured position within the bone and lack of proximity to critical anatomy.
- **Infection Risk:** While metallic fragments are usually immobile, they can still serve as niduses for infection, especially if contaminated or soft tissue migration occurs (9). None of the cases in this series showed signs of infection, supporting conservative management in specific situations.

Symptoms: As shown in the first two cases, asymptomatic patients without signs of inflammation or neural impairment are suitable for follow-up.

Surgical Accessibility: In the third case, removal was only performed during a second surgery in the same anatomical area, providing a low-risk opportunity to retrieve the previously retained fragments. These criteria align with previously reported cases where conservative management was deemed acceptable when the foreign body was well-encapsulated, non-mobile, and not in contact with vital structures (10). Surgical retrieval of deep-seated fragments can present significant risks, like nerve injury, excessive bone removal, and inadvertent damage to adjacent tissues. In maxillofacial regions with dense anatomy, unclear exploration can aggravate outcomes (11). Therefore, a "wait and see" approach is often the best option except for a clear indication or surgical opportunity.

Prevention starts with proper instrument selection and handling. Thin, high-speed burs are unsuitable for cortical bone and may break under excessive pressure (10). Surgeons should also verify that instruments are in good condition and replace them regularly. If breakage occurs, the initial attempt to remove the fragment should be done cautiously, with prompt imaging guiding further decisions. Piezosurgery might be preferred in some cases because its cutting action relies on microvibrations, making it less traumatic to the bone and instruments (12,13). Accurate documentation of the incident, imaging findings, and reasoning behind management choices is vital for medico-legal protection and long-term patient care. Patients should be informed about the retained fragment, potential risks, and signs to monitor. Informed consent is essential when opting for non-removal (14).

Conclusion

Though rare, bur breakage during oral and maxillofacial surgery remains a significant clinical event requiring careful management. The three cases illustrate that deciding between fragment removal and retention depends on precise localization through advanced imaging, such as CT scans, and a thorough assessment of the fragment's position, infection risk, patient symptoms, and surgical accessibility. Conservative management can be safe and effective when the

fragment is stable and does not threaten vital structures. However, removal should be considered when surgical access is feasible with minimal additional risk. Preventive measures—including careful instrument selection, proper surgical technique, and equipment maintenance—are crucial to reducing the incidence of bur breakage. Additionally, comprehensive documentation and clear communication with the patient are key components of best practice. Ultimately, each case must be evaluated independently to weigh the risks of surgical intervention against the potential complications of leaving a foreign body in situ.

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